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WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS.

Term Expires December 27th, 1884.

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* Resigned, 1883.

TWELFTH ANNUAL MEETING.

DECEMBER 27 AND 28, 1881.

PROGRAMME.

TUESDAY, DECEMBER 27.

Business meeting.

WEDNESDAY MORNING, DECEMBER 28, 9 o'clock.

Paper: "Land Communities among the Ancient Germans." — W. F. ALLEN, Professor of Latin and History, University of Wisconsin.

Paper: "The Number, Distribution and Function of the large Ganglion Cells of the Frog's Spinal Cord." —E. A. BIRGE, Professor of Zoology, University of Wisconsin.

Paper: "The Causes of Insanity."— A. O. WRIGHT, Secretary State Board of Charities and Reform.

Paper: "Medieval German Schools." —J. D. BUTLER, LL. D., Madison.

Paper: "The Dispersion of Drift Copper."—R. D. SALISBURY, Beloit.

WEDNESDAY AFTERNOON, 2 o'clock.

Held in Lecture Room of Natural History, No. 36, Science Hall, University of Wisconsin.

Paper: "Recent Observations on Cell-Divison and their Relation to Theoretical Zoology.— E. A. BIRGE,

Paper: (1) American Glacial History in the Light of Recent Investigations. (2) The Harmony of Recent Observations on Moraines, with Croll's Hypothesis of the Origin of the Glacial Epoch." — T. C. CHAMBERLIN, State Geologist, Beloit.

Paper: Proportional Representation in Legislation." — G. SCHUMM, Editor *Radical Review*.

WEDNESDAY EVENING, 7:30 o'clock.

Paper: "My Visit to the Hawaiian Volcano." — PROF. J. D. BUTLER.

Paper: "Human Liberty Empirically Considered." — PRESIDENT JOHN BASCOM, State University.

FREEDOM OF WILL EMPIRICALLY CONSIDERED.

By JOHN BASCOM, D. D. LL. D., President University of Wisconsin.

It is not our present purpose to present again the proofs of liberty in human action. These proofs are so primitive in their charater, approach so nearlythe first principles of reason, that later discussions of them between the defenders of philosophical systems do not often subserve any purpose of conviction.

The object we now have in view is a consideration of liberty as it offers itself in experience, first, in the relation of the mind to the brain; and, second, in the reaction between the powers of the mind and the products of those powers in the world about it. If we were to grant liberty theoretically, should we find its exercise possible under our present experience? This is the question we wish to answer.

It will not be amiss to remind ourselves in starting of the nature of the interests involved in this discussion of liberty. Moral facts are supreme facts in human society. The axiomatic principle on which these rest in the general mind is, Responsibility is commensurate with power. This involves at once choice as the indispensable condition of virtue. We are not considering in morals a balance of tendencies, but a balancing of tendencies — a dealing of the mind with tendencies. No adverse statement at this point has weakened the general convictions on which morality proceeds, or presented itself as more than an ingenious evasion of them. Virtue and liberty rise and fall together; whatever the one loses the other loses also.

The same relation belongs to truth and liberty. Truth is to be inquired into and sought out. It may be attained, and it may be missed. That movement of mind, therefore, which is to be occupied with this work of inquiry, must be flexible and spontaneous; must be at liberty to guide itself by the purely intellectual laws of logic. If thought is in any way subjected to forces beyond itself it can no longer shape itself freely to its own conditions. Conclusions reached under a

physical necessity have nothing to do with truth. They are facts, not truths. The laws of logic are not laws in this sense, the mind must move logically; but in this sense, the mind must move logically if it is to reach the truth. The implication is that the mind may easily move illogically, and miss the truth; that it shapes its own movement to its own object; that it is free, and that truth is the reward of freedom wisely exercised.

The beauty of the world involves a like conjunction of liberty and activity, though less obviously so. Beauty is fitting thought and feelings rendered in a form wholly suitable to them. Its pursuit involves, therefore, an ideal, and a spontaneous movement toward that ideal. Impulsion and force are alien to beauty. Attraction and freedom are of its very nature.

Nor, indeed, does the plain idea of serviceabless — rendered as man always will render it — lack this notion of liberty. The world is made up of forces that may be used, and of powers in man that may use them. It is made up of the fixed and the flexible, and neither term can be lost and the serviceable process remain. State the case strictly under the forms of empirical forces, and not only do virtue, science, art disappear, use also disappears. We use things in this higher sense when we shape them to our purposes. We use air not when we breathe it spontaneously, but when we fill our air-brakes with it. We use water when we convert it into steam in our boilers, rather than when we drink it under an organic impulse. If the world, both in matter and in man, is made up of forces under settled laws of interaction, man no more uses matter than matter uses man. If we include in the natural what is causal and fixed, and in the supernatural what is free and flexible, the natural can never be in any way handled or interpreted or used without the supernatural. Whenever interpretation reaches either comprehension or use it must do so by virtue of the supernatural, and in behalf of the supernatural. To these ideas of knowledge and of service the one is as necessary as the other. The knowing and using agent is not at the same

time and in the same relation a part of the thing known and used.

Human knowledge and human liberty fundamentally planted in this union of the physical and spiritual, as we here conceive them, show empirically two lines of limitation. The first of these appears in connection with the brain, the medium by which the mind receives influences, and the instrument by which it communicates energies. We may pass at once to the extreme conclusion which science is approaching, that the nervous system in man, with its great centre, the cerebrum, is constructed throughout with definite lines of inner and outer movement. Organic connections differ from mechanical ones in admitting a greater variety of offices, and allowing a freer substitution of one organ or one method for another; yet a distinct constructive purpose rules an organism as it rules a mechanism. The definiteness of the nerves and of the exterior termini of nerves in the nervous system carries with it a corresponding definiteness of offices both in them and in the great nerve-centres. Exactness in superficial relations without exactness in interior ones, would be futile, the meaningless juncture of order and disorder. The distribution and precision of the surface indicate like exact inner relations in completion of the one plan. Observation of the effects of obstruction and of disease in the brain, and of artificial irritation of its different localities, serves also to disclose explicitness of office combined with organic flexibility.

There is nothing in this which liberty may not easily accept. This dependence of the mind on the body gives strict conditions to liberty, but does not take away its first terms. The tool is an instrument to the hand; the hand is an instrument to the brain; the tool, the hand, and the brain are conjoint instruments to the mind. The workman cannot go beyond the possibilities of his tools. His circuit of liberty lies within those possibilities. The mind united to the body receives from it what we may call two sets of limitations, or two sets of powers as we choose to regard them: those which pertain, in the senses, to the ingress of knowledge, and those which pertain, in the muscular system, to its egress in ac-

tion. The nervous system is the medium in each case, and the bond between the two.

The only view which at all interferes with liberty at this point is that which regards all action in consciousness as a secondary accompaniment of this interplay of stimuli and activities in an organism, and so determined in its phenomena by it. If the chief nerve-centres, more especially the cerebrum, in man are the seat of a series of interactions which take place between the inward movement and the ontward one, and are governed by them; if the phenomena of consciousness are simply the accompaniments of these complex actions and reactions in the brain, then liberty is lost, not limited, by such conditions.

The adverse reasons are many. (1) A very large share, much the largest share, of nervous interplay goes on both in the lowest and in the highest life without consciousness. Consciousness is certainly no necessary product of merely nervous interaction. (2) Consciousness regarded in this light is from beginning to end a superfluous term. If consciousness is incident to forces seeking directly their own ends, we have no more use for consciousness in living than in dead things; no more need of it in securing the muscular activities that follow thought than in the circulation of the blood, or in uniting the recognition by the eye of the characters on the printed page with the muscles of the throat in articulation. If no state of consciousness is of itself productive of subsequent states of consciousness, but all are alike dependent on underlying cerebral conditions, then each state of consciousness and the entire series of states are, in reference to physical events, supernumerary results. Between these states and these events it is impossible to affirm any correspondence which is of the nature of knowledge. (3) Consciousness has been introduced in development, on the contrary, as a new term in a higher life, incident not simply to organic relations, but one that seems greatly to extend them and put them to new service. (4) There is no known counterpart of any given thought in any given molecular changes of any nerve substance. The first and fundamental step of proof in this direction has not yet been taken.

The whole theory of correspondence has not one explicit fact to sustain it. The senses are definite in their outer conditions and inner impressions; the activities are definite in their inner conditions and outer effects; but our experience does not extend or cannot extend to any pure mental state as the exact counterpart of a physical one embraced between these two lines of ingress and egress. Arguments looking to such a conclusion are all inferences from insufficient grounds.

There are two contrasted views that we may take of the relation of the processes of pure thought to cerebral action. We may regard them as strictly incident to cerebral changes which intervene between sensation and action. This supposition implies an exact and causal connection of each specific cerebral state with a corresponding state in consciousness. The line of efficient forces is thus maintained in the physical world. Or, we may regard pure intellectual activity as a distinct term, under its own laws, which is introduced between sensor impressions and muscular actions, as the musician is an independent agent between the sheet of music that lies on the piano and the instrument itself. On this supposition the mind as mind receives impressions, correlates them in its own fashion, arrests them or passes them on in effects according to its own ends. We may, if we choose, modify this second opinion by still further supposing that there is a distinct molecular state of brain as the necessary accompaniment of each thought, but that it is secured by existing states of mind and not by antecedent sensations. This expansion of the theory, however, seems to be a weak concession to physical ideas, as no such correspondence can be proved, and the cerebral states thus accompanying pure thought would have causal connections neither with antecedent nor subsequent cerebral states, would be a dead term in the material world, and serve no known purpose in the mental one.

This intervention of mind does not imply any chasm in physical sequences, any break of relations between sensations and actions, but simply the power of the mind to penetrate, and in a great variety of ways to modify, these

connections; thus heat alters physical sequences, without interrupting them. The change does not lie in the insertion of alien terms, but in the control of congenital ones.

Several empirical reasons are urged for the strict dependence of thought on cerebral states. In insanity, it is said, the mind is subverted in its action simply by disease of the brain. But this it should be under either view. The mind is dependent for its facts or supposed facts on a nervous organism, and an abnormal state of the organism may wholly alter the data of thought. The quickness, however, and accuracy with which the patient reasons from his premises are often very observable. If the sensor and active physical powers are broken down by disease, the mind on the one side loses data, and on the other side the power of expression. Aphasia, or the inability to utter or to write words, is often offered as a proof of this dependence. This fact, however, seems to look in the opposite direction, as the idea is still grasped by the mind even when it cannot control the organs of utterance.

But the experience which looks most directly to a constant and complete dependence of thought on cerebral conditions is the sense of fatigue and the waste of nerve-tissue which accompany the action of mind. This fact requires careful consideration. Under all theories the brain is the medium of impressions and expressions, and the action of the mind lies between the two. The only question is whether it lies as intervening cerebral links between cerebral states, to which connection thought is incidental; or as a relatively independent spiritual power to which no cerebral state need be set apart. In either case the action of mind involves sensor activity and motor activity, and this, too, in a much higher degree than is usually thought. It is this incipient or complete ministration of sensor and motor action of the brain to the mind that we would regard as a sufficient explanation of the fatigue of mental activity.

Things and words are the counters of mind, and without them it can make only the feeblest advances in reflection. But things involve sensor impressions, and our acts of attention, analysis, and arrangement involve sensor impressions

and motor activities. The sensor and motor terms are as omnipresent in inquiry as are the two poles in an electric current. Still more if possible is this true in the use of words, the most intimate and constant means of thought. When the words of others direct us, they become sensor impressions that call for careful attention. When we ourselves guide our thoughts by words, they are either distinct motor terms or *quasi*-motor terms.

All acquisition commences with language and seeks its constant aid, and as language has a definite cerebral term involved in its use and expression, we find in this fact an occasion for a consumption of nerve-tissue in all mental action. Children, if circumstances admit the habit, prefer to study aloud; that is, to aid the comprehending process by a full use of its counters. If the habit is inconvenient, the pupil will often move his lips without emitting any sound. He still finds the incipient utterance of the accompanying words a help to the mind. Some adults are aided in understanding a book by reading it aloud. All persons observe the much greater clearness of thought which follows the utterance of one's conclusions or the writing of them. Even dreams frequently lead to talking in sleep. All these things show that it requires considerable effort on the part of the student to reduce the language which he employs in thought to its lowest terms in nascent expression.

A little attention to our mental processes will show us that language never disappears in thought, but that our most silent processes still go forward by its aid. This dependence of thought on expression is also well illustrated in the education of mutes. "Though the deaf-and-dumb prove clearly to us that a man may have human thought without being able to speak, they by no means prove that he can think without any means of physical expression. . . . Herein lies the necessity of utterance, the representation of thought. Thought is not even present to the thinker till he has set it forth out of himself. . . . The deaf-and-dumb gesticulate as they think. Laura Bridgman's fingers worked, making the initial movements for letters of the finger-alphabet, not only during her waking

thoughts but even in her dreams. . . Heinicke gives a description of the results of his teaching his pupils to articulate, their delight at being able to communicate their ideas in a new way, and the increased intelligence which appeared in the expression of their faces. . . . The teachers of Laura Bridgman used to restrain her from making inarticulate sounds, but she felt a great desire to make them, and would sometimes shut herself up and 'indulge herself in a surfeit of sounds.' But this vocal faculty of hers was chiefly exercised in giving what may be called name-sounds to persons whom she knew, and which she would make when the persons to whom she had given them came near her, or when she wanted to find them, or even when she was thinking of them. She had made as many as fifty or sixty of these name-sounds." * These cases indicate the aid which the mind immediately receives from any method of expression, and the consequent pleasure it takes in it.

Deaf mutes are accustomed, in acquiring their lessons, to spell out the results on their fingers. The training of imbeciles opens with an effort to give them a better control of their hands, their senses, and their organs of speech. Impotence, vagueness, uncertainty in these directions are the expression of kindred mental qualities. One who does not articulate words well finds difficulty in recalling them.

When a name we have forgotten is rightly articulated we recognize it at once. Language is the full realization to the mind of its own activity. We are also to bear in mind the greater fatigue which attends on thought when it receives full vocal utterance, as in oratory. The accompanying activity of the nerves and organs of articulation with the necessity of continuous and rapid expression often make the fatigue very great. This labor is also much increased if the subject discoursed on is one whose vocabulary we have not fully mastered, or if the discussion is carried on in a language with which we are not perfectly familiar.

On the other hand, an exact but familiar process, as the multiplication of large numbers, is much more trying if we

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* "Early History of Mankind," pp. 67–74.

are compelled to carry it on mentally, and are not allowed visible counters. In this case the steps are no more difficult, but the difficulty of retaining them is greatly increased. Mere reverie, in which the transitions are very loose, is restful rather than fatiguing.

It is an ultimate fact in neurology that connections once established in images or in actions, become increasingly easy and spontaneous. The power to utter words by rote, into which complete memory is constantly passing, is plainly the result of nervous and muscular training. Literary matter which has just been learned can be repeated but slowly and hesitatingly. A repetition on successive days greatly increases the facility of movement, and a repetition at distant periods very much strengthens the hold of the mind. We often render aloud lines of poetry, giving full sway to the rhythm, as a means of recalling one or more missing words. The loss of memory by disease and its restoration of health find explanation in these neural connections. More recent occurrences suffer most from this loss of recollection, and the power of memory returns by first regaining more distant events, those whose connections have been fully established in the nervous system. This method of restoration is made plain by the simple fact that memory is supplemented by vital connections in the nervous system of perceptions and of actions. A memory which easily lays hold of an idea, but retains with difficulty the precise words in which it is stated, is doubtless to be explained by diversity in the cerebral conditions of language; as much as is hesitancy in speech as contrasted with volubility. Memory is evidently much modified by the fact that it so often involves the physical condition of expression.

More than one instance of this kind has come to my knowledge. A person, awakened from a deep sleep, has recalled certain thoughts that were present to the mind, and also words that accompanied them. Giving the subject closer atention, he has been surprised to find that the words did not belong to the thoughts, but seemed to have been evoked vaguely by them. The thought-process stirred the faculties of expression without controlling them. In like

manner sounds that enter the ear are distorted in dreams so as to suit the circumstances of the dream, rather than the external fact. Both of these results indicate a momentary separation between the thinking process and the organs of expression and preception which accompany and sustain it.

The hesitancy and difficulty with which the mind sometimes meets in trying to recall a word seems to lie in the feeble hold of the memory on the one side, and the inability of the mind to guide the organs of utterance on the other. The image of the written word and the sound of the word are both partially present, and both fail of perfect form. Thus one may have uttered yesterday a difficult sound, and have lost to-day the power of repeating it.

If we allow an exact correspondence between cerebral condition and pure thought, we confound the distinction between instinct and reason. Instinct is plainly characterized by a direct connection of external stimuli with appropriate actions; the transition being, however, more or less protracted, and united with the ordinary variable experiences of life. Reason, under the view now combated, would be simply an extension of instinct, whereas it manifests itself not only as a new combination of powers, but also as one that is constantly setting instinct aside and reducing it to its lowest terms.

This theory of an exact correspondence between cerebral states and rational activity makes no sufficient and no plausible provision for the growth of rational powers. Cerebral states and cerebral actions are not inexhaustible. If a distinct combination is demanded by each distinct thought, and if memory requires the preservation of these combinations, the capacity of the brain would be steadily exhausted by its development, and we should experience in reason, as we do experience in instinct, limits to mental unfolding. So small a substance as the brain cannot, in its molecular states, be the counterpart of the entire universe in all the actual and possible relations of its parts. There must be some limit to the discursus of reason if each thought appropriates a definite portion of a limited power. The theory is unreasonably complicated, and in that degree

improbable. It would also imply increased difficulty in the acquisition of mental power, when the facts disclose increased ease. Nor is it any relief to this embarrassment to say that the special senses, like the eye, give the mind very complex impressions by an equally complex organic state. The image of a landscape is displaced by each succeeding image. The eye is a specialized organ that has been developed to its present power by stages of growth that date back almost to the beginning of animal life, and yet its maximum power is represented in the reproduction of a single landscape, with very great limitation of distinctness of vision beyond the immediate centre of observation. The method and degree of reproduction in the eye and the ear give no color of plausibility, but the reverse rather, to the supposition that the cerebrum has in its molecular action an exhaustless representative and retentive power both in the regions of imagination and of abstract thought.

Mathematical truth and all exact knowledge lead to the opposite conclusion. Cerebral states as physical effects can never be the precise counterparts of each other in different brains. No truth, therefore, dependent on such states could be absolute and universal. Some kind of color-blindness would sooner or later show itself in all directions.

The deductive reasons already referred to come in to confirm this conclusion of the relative independence of pure thought in an unmistakable way. No physical relation can be the equivalent of logical convictions; and no convictions can be merely physical effects. The two lines of law are not parallel, and cannot be made the counterparts of each other. The conditions of thought are not those of force.

We may then pass all strictly physical experience as indeed giving limits to liberty and sometimes limits crowding very close upon it, but limits that never abolish it as long as thought remains. We turn now to our intellectual experience in its relation to freedom.

Men start with a balance of powers and a bias of disposition which are not easily modified or resisted. This natural disposition is the result of primitive passions and tastes that are stubborn facts by no means to be wiped out by a simple

choice, nor indeed altogether to be rooted out by the most faithful and continuous effort. A portion of these proclivities may be attributed to physical inheritance, and a portion to original endowment. For our present purpose we need not strive to settle the balance between them or even stop to enforce the existence of the second constituent. The position of the individual in reference to liberty is not much altered whether his first make-up comes to him by descent or by gift, or by a combination of the two. The stubbornness of these first tendencies experience clearly records. Those who have the training of children attach great importance to parentage and antecedents. Even in the earliest instruction these forces make themselves felt. The parent and the teacher are constantly aware in the same household of diversities of temperaments and tastes as fundamental considerations in discipline. It is true that much more can be done in shaping these forces early in life than later in life, but they can at no time be overlooked, and will often undo unskilful and even skilful labor in a sudden, resentful way.

It is also to be remembered that the moral inheritance of early surroundings and discipline so adds itself to, and incorporates itself with, primitive endowments as to be practically inseparable from them. By the time a young man begins to come within the range of his own personal freedom a composite stream of strong currents has him in hand. He need not lose time to inquire how he came by his inclinations, whether by native endowment, by physical inheritance, or by direct instruction; to guide and shape these energies, already realized in volume and direction, becomes his sufficient labor. The limitations of liberty are, therefore, very obvious and very great. They are allied to those of a gunner whose position and piece are given him. Said an active boy in answer to the complaints of his sluggish companion, "I do not walk so fast on purpose, I cannot help it." If we look at the limitations of liberty in reference to the immediate actions that are to follow them, we may regard freedom as not having much to do with the ordering

of life. Indeed, hasty reasoners often come to this conclusion.

A restriction closely concurrent with this of primitive disposition is that of habit. We all become increasingly aware of this restraint as we advance. We are not simply hampered by physical habits, but by intellectual ones also. The lines of thought we have taken up we pursue with increasing ease, but we are at the same time more and more reluctant to accept new ones. In youth we were adepts in mathematics or quick in languages; in middle life we discover we have much narrowed these powers by disuse. We have passed the point of indifference in reference to any class of attainments, and find them all positively easy or positively hard.

The convictions we have reached, especially those touching action and character, personal, social and religious, though they themselves may have grown up in the exercise of liberty, are still limitations upon it. Especially is this true if a dogmatic spirit enters into them and we regard our opinions as finalities.

What Lanfrey says of Napoleon is capable of much wider application. He is speaking of wilfulness — which is really the want of well-ordered will — as united with very great intellectual powers. "The studied frenzy of a calculating mind is without remedy, because it does not depend on a sentiment, but on the very form of the intellect itself." This is true of all mental activity in proportion as it becomes deep and narrow. The life flows on in it as a river in a cañon, not merely beyond flexion, but for the most part beyond observation. A dogmatic intellect does not simply open before us one way, it systematically closes up all other ways. Dogmatism is a universal loss of liberty, and most of all in the inner life of the mind.

The remoteness of primary principles from the truths which flow from them leads to the same result. Most of the discussion by which the current of empirical philosophy is resisted in our day goes for little or nothing. It lies far out among marginal truths, and can find no acceptance with minds adversely disposed, and rarely leads to a fundamental

renovation of thought. A boy sits upon the bank of a stream and gives his slight boat an impulse up the current; it soon returns to him, because the water flows in the opposite direction. The tidal movement of many minds is something not often comprehended, difficult to be resisted, and hard to be overcome. While the questions involved are questions of reason, the questions are very many, and the reasons very many, and are arrayed like armies. Single men or single regiments of men, can no longer wage successful war.

Another restraint which overtakes freedom in its unfolding is that which arises from the accumulating force of feelings and of social relations. It is thought that the minds of women are less open to the force of reason than those of men. So far as the assertion is true, it is largely due to the emotional energy which characterizes them. This medium of thought refracts and colors the light on all personal topics, till a presentation is insensibly reached that suits the temper of the inquirer. Light is full of all colors, and will yield them all according to our analyzing prism. Wise men find that in dealing with the foibles of others they must not expect to remove them, but rather to accommodate themselves to them. Friends that undertake thoroughly to correct each other will soon reach aversion. Refractions that belong to the very atmosphere of the mind itself must be patiently borne. It is far easier for those who see these disturbances of vision in others to endure them than for those who suffer under them without recognition to remove them.

Not only are the feelings themselves very persistent forces, all our social relations become objective provocations to them, renewing them constantly and with great energy. As we interpret society to-day we interpret it to-morrow; and it acts on us vigorously to perpetuate ruling impressions. Hence it is not our own emotional atmosphere simply, but the atmosphere of the world we live in, that is unbraiding the light for us, and casting sombre or brilliant colors on the objects about us. To these physical and intellectual restrictions are to be added secondary ones which arise from their interaction. Disease, fatigue, old age, success, failure, predispose the mind to certain judgments which are not eas-

ily cast off. The unsuccessful man becomes untrustworthy in his opinions.

We care not to trace these limitations further, but wish rather to inquire how they leave the problem of liberty. So profoundly are some minds impressed with these subtile and overwhelming influences that human liberty sinks out of all high estimate. Life seems but a painful beating of the waves of the ocean by a swimmer who must ultimately sink. Constraining forces are of the most pervasive and insinuating order; they are often nearest us when we think least of them, and bind us most when we seem to ourselves most free.

Accumulative impressions, like those now brought forward, require corresponding care in the search for compensatory considerations or they quite confound the thoughts. We are too much accustomed to think of liberty as the immediate casting off of restraint, and as efficient, therefore, in the degree in which this is accomplished. This is far from the truth. The value of liberty lies in its power to work under and with invariable and permanent forces. If liberty involved mobility simply, it would lose its possessions as fast as it gained them. The air is mobile, and for that reason its distribution of parts has little interest. We can carve nothing out of it and record nothing on it. Rocks are comparatively immobile, and immediately they become material in many forms of work, while their distribution is an important fact. If results followed on after vagrant wishes, choice would gain apparent power, but would suffer immense loss. The thing done would be as quickly undone, and the clash of choices would be as idle as the collisions of winds. Indeed, there can be but one Aladdin with his magic lamp. He alone must be left to act on things fixed and permanent for all but himself. A pair of them would subvert the world, become spirits with invulnerable bodies who could settle nothing in conflict.

The resistance which surrounding conditions offer to liberty represents the strength and tenacity of the material at the service of the mind, and is a question simply of the right degree. If the resistance is slight, the gains are slight; if

the resistance is great, the labor must be great, but so also may be the results.

Now the individual and the race encounter in the exercise of freedom two lines of resistance: that offered by matter and that offered by the mind itself. The first of these is, in the strictest sense, the coherence and firmness of material. It is the office of mind, availing itself of inorganic and organic laws, to permeate matter and hold it to fixed and extended service. The most complete illustration of this is the human body, penetrated in every part with nerves of sensation and action, and so becoming not itself merely an arena of mind, but a powerful instrument of mind, operating by means of it freely in the physical world. To complete this mastery of mind over matter, to establish it as a settled intellectual dynasty, is what wise men are about in the world. Now material laws are sufficiently pliant to thought to make this labor possible, and sufficiently resistful to make the gains of infinite worth when secured. Men soon learn that mere vaporing accomplishes nothing, but they also learn that skill and patience are surprisingly effective. The stream does not flow like water, but it flows like a glacier. It can hardly be said that the physical material offered the hand of man is so intractable as to waste liberty; it has rather that degree of tractability which stores liberty.

But the second line of resistance is one of equal interest — the restraints which the laws of mind offer to mind. It has been found a universal social law, that if freedom is to grow, wisdom and virtue must grow with it. It is the same truth we are contemplating in the limitations of liberty within the mind itself. The agency slips away from the agent unless the agent masters himself also. While man is held back from the control of the physical world by laws within that world, he is equally held back by laws within himself, and the two sets of laws must be handled together and mastered together; otherwise the movement will soon find arrest. When the mind stagnates within itself its external force is lost also.

What do the limitations of freedom which we have found arising within the mind itself signify but this, that the grow-

ing points of intelligence and virtue must be carefully maintained? If these are lost, freedom is lost. The mind settles down under fixed opinions, becomes subject to an unbroken sequence of feelings, and accepts the social sentiments that prevail about it.

The one condition of freedom is to maintain unimpaired intellectual activity in all directions of action. This alters the horizon, varies the grounds of effort, breaks up and subordinates habit, and holds in arrest the aggression of other minds. The mind that ceases on any topic — for instance, on that of religion — from fresh intellectual activity has turned down the light by which it should be guided, and it is only fortunate, therefore, that it begins to fall into a calculable routine of action, that it does not go plunging on with nothing to direct it. When the buds of a tree cease to shoot the leaves may come and go for awhile with the seasons, but the constructive life is arrested. The limitations of liberty do not show the power of man to be nothing, but only that there are moments, places, and ways of its skilful application.

We are not to conceive liberty in men as a gigantic power, easily executing its purposes and holding fast results with a firm grasp. We all start under conditions alien to ourselves, organic influences, educational influences, social influences. Here is a young man brought up on a farm to hard labor, close economy, and a limited intellectual horizon. External circumstances and parental precept and example have concurred in deepening the ruts in which he is slowly moving onward. None the less it is possible that some new activity shall come to his thoughts, that he shall of a sudden say to his astonished father, on the occasion of some new exaction, "I do not think so." From that moment he may begin to break the cords that have bound him, and, in the progress of years, get to himself new incentives with a new outlook. Motives have force, not in themselves, but in relation to the mind to which they appeal. Change the mind and you change the motive. When a man thinks to some some new purpose the chains of custom drop off him. Every man, in his experience, is liable to share the astonishment

of the father, when his son says to him for the first time, "I think differently." As a man thinketh so is he. Here is a pivot of revolution which no external facts can control, but upon which they in turn are dependent. If we introduce liberty in human action at this centre of thought, and leave it to extend itself by a steady modification of internal conditions, and to maintain itself by fresh acquisitions, freedom is reconcilable both with the theory of life and the facts of life, and is seen to be the one significant factor in them both.

If there is a slow accumulation of circumstances about one which hedge the way, the fact is due to the passivity of the mind in the ripening of events. If the mind is active and watchful, this infinite division of particulars, this slow gathering of difficulties are in favor of liberty. By foresight and effort the mind increases its powers of resistance and guidance. The problem of life is indefatigable will at war with unwearied forces, but forces can be divided against themselves, and enlisted on the side of will.

While spontaneity exercised in thought — and in this way productive of light — is the condition of continuous freedom, the condition of the condition is virtue, feelings that turn on and subordinate themselves to the truth. If the intellectual movement is not honest in its incipiency it shortly fails of thoroughness. It is not light alone that is the efficient constructive force in the green tissue of leaves; it is light and heat. It is not truth alone that maintains the vitality of growing points in the mind, but truth and feeling. Feelings that are alien to the facts soon alter our conception of the facts, and so the facts shake us off and escape us. We are not masters, because we have lost the true word of command.

Personal liberty is like liberty in the state. Its safe possession is one of profound obedience to deeply implanted principles. It is not, therefore, the less liberty or of less worth. On the one side the very condition of strength is a struggle with domineering tendencies, and on the other their steadfast government under new conditions. Liberty is a movement from law to law, each succeeding law being higher, broader, more inclusive, and more fortunate.

The value of liberty is that it enables the mind freely to conform to law. The liberty that does not pass instantly into law is like the seed that is not sown in the soil. It abides alone. Liberty that confines itself to its narrow field, that is content to knit skilfully together the past and the future at the one plastic point, the present, is not weak, it is well-nigh omnipotent. It only requires long times and large spaces in which to unroll its power; it merely calls for material of every order and the union of every law by which to record its work. There is no reason in any limitation of liberty why, under the laws of inheritance, man should not in time walk the earth with the bounding life of an archangel, govern it with the strength of an archangel, and take home its thoughts and feelings to the pure and serene experience of an archangel.

The one law of this progress is continuous intelligence and virtue.

THE INCREASE OF INSANITY.

By A. O. Wright, Secretary of the State Board of Charities and Reform.

The United States census of 1860 showed in the state of Wisconsin 283 insane persons. The census of 1880 will show probably about 2,000. This is not an isolated fact. An increase of insanity is shown by these two enumerations in the twenty years from 1860 to 1880 in every state of our Union, and in some of them as great an increaee as in Wisconsin. Is the increase a real increase, and what are the causes of it?

I. This is not all a real increase. The census of 1880 was taken much more accurately than ever before, and this increased accuracy shows itself especially in the enumeration of the defective classes. The United States deputy marshals were sometimes careless in counting the numbers of population, and much more careless in gathering such special statistics as those of the defective classes. Their sins were

generally of omission rather than commission, and therefore the more accurate methods of the last census caused an apparent increase in the number of the insane, as of all the defective classes. Thus this census will show in Massachusetts one insane person to every 338 of the population instead of one to 350 as before supposed.

II. An apparent increase of insanity is caused by the wider definitions of insanity given nowadays by physicians in charge of insane hospitals. A wide range of diseases of the brain and of mental and moral perversions is now called insanity, which formerly would have been called nervousness, or eccentricity, or wickedness, as the case might be. Consistently with this theory an expert witness lately testified in the Guiteau trial that one in five persons on the average are insane. The effect of these teachings has been to cause many persons now to be considered insane who formerly would not have been so considered. The disease or the mental or moral perversion would have been there, but it would not have been called insanity. The increase of insanity from this cause is like the astonishing increase of some cities, made on paper by taking in outlying suburbs.

III. A very large apparent increase of insanity has been made by the better care now taken of the insane than formerly. The barbarous treatment of the insane which lasted as the rule in Wisconsin down to about 1860, when the State Hospital was fairly opened, and after that in most jails and poorhouses until after the State Board of Charities and Reform began their work of improvement of those institutions in 1870, and which is still found in a few places in this state to-day, tended to greatly shorten the lives of the insane. Living in filth and squalor, chilled by frost and scorched with heat, given too little food and drink, shut in dark, damp dungeons away from the healing beams of the sun, they died rapidly. Now, under humane treatment, with proper food, warmth, exercise and fresh air, the chronic insane live at least as long as the average of mankind. There is little in the mental disease itself to destroy life, and people cared for according to the laws of health in hospitals and county asylums are less liable to disease and death than

those who are free to neglect their health outside of insane asylums. Now this process of preserving the lives of the insane has been going on in this state for the last twenty years with the inevitable result of increasing the number of the insane. For while as many have been becoming insane as ever, fewer have been dying off, and thus the number insane alive at any given time is growing greater.

IV. Another cause of the increase of insanity is the increase of population. Wisconsin has increased from 775,000 in 1860 to 1,315,000 in 1880. While the population has nearly doubled it is not wonderful that the number of insane should increase also.

V. An important cause of the increase of insanity in this state is that Wisconsin is passing from a new state to an old settled state. The first generation of pioneers who settled the southern part of the state are passing away. When they came here, they were usually people of vigorous health and in the prime of life. Like most settlers of a new country they left their defective classes behind them. There were few insane among the immigrants who came first or among those who have followed them since from the eastern states or from foreign lands. The cases of insanity we have had have mostly been produced upon our own soil. Now, bearing in mind the great part that heredity has in producing insanity, it is plain that a body of immigrants selected for healthfulness of body and mind, as nearly all immigrants are, will have less insanity for several generations than the people of an old settled country. The ratio of insanity to the population will show this. The census of 1860 shows insanity in the ratio of one insane person to every 2,740 of the population. A census which I have recently taken of the insane under public care which is at least as imperfect as that was, because it gives only those under public care, and not those cared for at home, gives a ratio of one insane person to every 743 of the population. This shows a sufficiently rapid increase in the ratio of insanity. But the same census when shown by counties as in the subjoined table, and illustrated by the map which I have prepared, shows very clearly that the in-

crease in the ratio of insanity has been in the older settled counties. Thus the same law is at work within the state as between the counties which is at work upon the state at large.

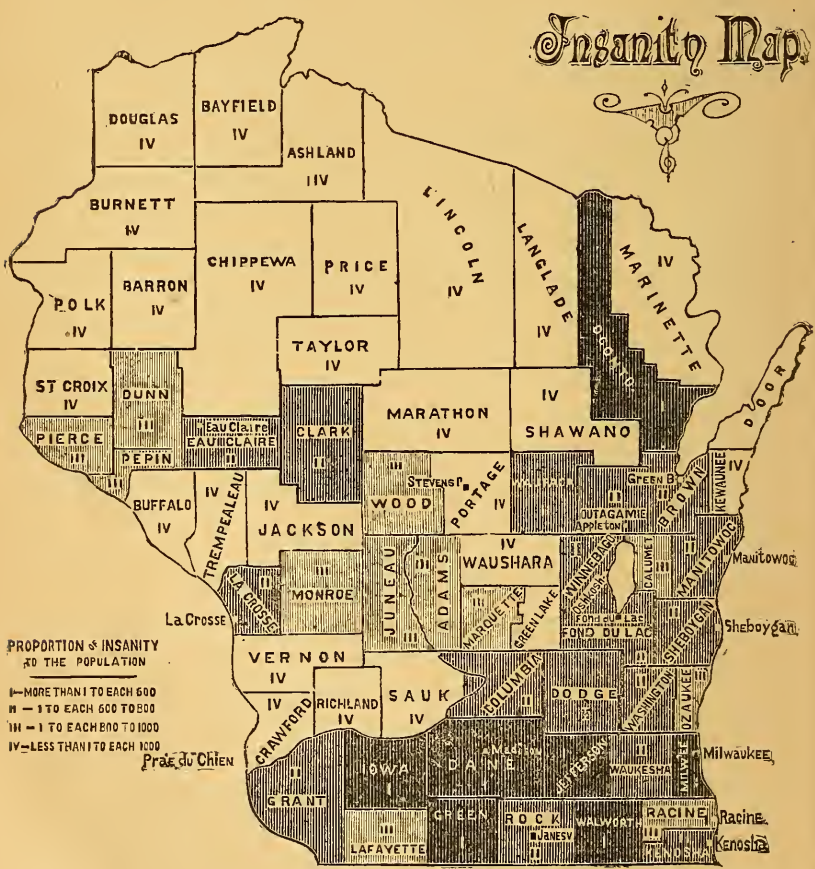
When the results of the United States census of 1880 in regard to the insane are published, there will probably be about 2,000 insane shown to be in the state or one to every 656 of the population.

Of the five causes for the apparent or real increase of insanity, we may suppose that hereafter we shall have as accurate returns of insanity as the nature of the subject admits of. While it is questionable whether certain persons are insane or not, no one can count the insane with entire accuracy; but they will be hereafter counted as accurately as possible. The second cause in the wider definitions of insanity has gone about as far as it is likely to go in increasing the number of the insane. If anything, there is likely to be a reaction as the result of Guiteau's trial, and of other causes, to narrow somewhat the definition of insanity and thus slightly reduce the number of those called insane. The increase of insanity caused by the more humane treatment and therefore longer lives, is, we may trust, a permanent increase. Rather than resort to the old, barbarous methods, it would be far better to give these poor creatures the euthanasia afforded by an overdose of laudanum. If they are to be killed off, let it at least be done without unnecessary cruelty. But though the increase in the number of insane from this cause is doubtless a permanent one, it will not be as rapid in the future as in the past.

When the expectation of life among the insane has once been permanently lengthened by more humane modes of treating them, they will not continue to accumulate forever, but will die off as before, only at a greater age. We have not yet reached the end of this change for the better in the treatment of the insane. But when we have done so, then this source of increase will soon cease. The increase of population in our state will doubtless go on, but at a slower rate, and with it necessarily that increase in the total number of insane which goes with it. The increase of insanity, which

arises from our state becoming an old settled state, will of course keep on until we attain our fair average.

What that average is becomes then an interesting question. In Massachusetts, as I learn from Mr. F. B. Sanborn, who has charge of that subject there, the rate of insane to the population is about one to 338. In Scotland it is about one to 290. If we assume that we shall reach the ratio of one to 500 under public care in twenty years more, and shall have a population then of 1,600,000, both low estimates, we must expect in 1900 to provide for at least 3,200 insane persons.



If supported in state institutions at anywhere near the rates these institutions now cost, the charge to the public will be at least $640,000 annually, besides $3,000,000 for buildings, a burden which the state will find it difficult to bear. This whole question is one which is now pressing on us for solution and which deserves the attention of every philanthropist and every statesman.

TABLE SHOWING INSANITY IN WISCONSIN BY COUNTIES, 1884.

Counties.	Total insane under public care.	Ratio to population: one to each.	Counties.	Total insane under public care.	Ratio to population: one to each.
Adams	8	825	Marathon	8	2,140
Ashland	0	.....	Marinette	5	1,786
Barron	4	1,756	Marquette	9	990
Bayfield	1	564	Milwaukee	240	572
Brown	44	775	Monroe	21	1,029
Buffalo	5	3,106	Oconto	18	547
Burnett	3	1,047	Outagamie	42	684
Calumet	17	978	Ozaukeee	19	814
Chippewa	11	1,408	Pepin	7	889
Clark	14	765	Pierce	21	845
Columbia	40	700	Polk	9	1,112
Crawford	11	1,422	Portage	14	1,266
Dane	89	598	Price	0	.....
Dodge	67	685	Racine	37	836
Door	11	1,059	Richland	11	1,652
Douglass	1	655	Rock	53	733
Dunn	20	841	St. Croix	13	1,458
Eau Claire	26	769	Sauk	25	1,149
Fond du Lac	78	660	Shawano	9	1,152
Grant	59	641	Sheboygan	54	633
Green	37	587	Taylor	1	2,311
Green Lake	12	1,207	Trempealeau	15	1,148
Iowa	41	576	Vernon	23	1,010
Jackson	13	1,020	Walworth	50	525
Jefferson	58	554	Washington	37	634
Juneau	16	974	Waukesha	46	629
Kenosha	21	644	Waupaca	29	723
Kewaunee	12	1,316	Waushara	9	1,410
La Crosse	37	732	Winnebago	54	751
La Fayette	25	851	Wood	10	898
Langlade	0	.....	State at large	47	.....
Lincoln	1	2,011			
Manitowoc	62	605	Total	1,773	743

THE INCREASE OF INSANITY.

SECOND PAPER. 1882.

By A. O. WRIGHT, Secretary State Board of Charities and Reform.

Last year I presented to the Academy a paper upon the increase of insanity in this state, in which I gave a census of the insane under public care, by counties, the first ever made in the state, showing that we had then 1,773 insane persons under public care or one to every 742 persons in the state, and predicted that we should probably reach the number of 3,200 insane in the state by the close of this century.

I have completed another census of the insane under public care, and am able to give statistics for this year. There were on September 30, 1882, under public care in this state, 1,913 insane persons. This is an increase of 140 over last year. If the same increase occurs for the next eighteen years, or until 1900, we shall have about 5,000 insane persons at that time under public care.

On the supposition that we shall have about 1,600,000 population at the close of the century, that would be one insane person to every 320 of the population, or not far from the proportion of Massachusetts.

But it is not likely that the increase during the whole period will be so rapid, or the number of insane at the end of the century so great as these figures seem to show. In all probability insanity will continue to increase until eventually we reach the ratio of Massachusetts or even of Scotland, one to 290. But this increase will be by a continually retarded ratio. As the number of the insane increases, the rate of increase will grow less, until some fixed ratio is reached, from which the variations will be slight and temporary, as long as the conditions of society remain the same.

The increase, or in some cases, decrease, of insane by counties, is shown by the following table:

The counties which have had the largest increase are:

Milwaukee	27	Chippewa	7
Winnebago	14	Columbia	7
Green	11	Trempealeau	7
Brown	9	Buffalo	6
Sheboygan	9	Calumet	6
St. Croix	8	Iowa	6
Waukesha	8		

The counties which have had a decrease of insane under public care, are:

La Crosse	6	Washington	3
Manitowoc	5	Pierce	2
Racine	4	Eau Claire	2
Clark	3	Green Lake	2
Dane	3	Pepin	2
Dodge	3	Kenosha	1
Door	3	Wood	1
Fond du Lac	3		

The decrease in the insane under public care may come from three different sources: The insane may recover, or at least improve so much as to be discharged from public care; they may die; or they may be returned as chronic insane from the state institutions to the counties, and in consequence of the counties having no adequate provision for them they may be left under private care by their relatives. Decrease, of course, occurred from all these causes, and in the counties just named the decrease from these causes was greater than the increase from new cases of insanity, or from old cases placed under public care. From the fact that none of the counties have had during the past year adequate accommodations for the chronic insane, though some of them are preparing such accommodations, I think it is fair to conclude that in most of the counties this decrease is not a real decrease of the insane, by death or recovery, but only an apparent decrease, caused by sending chronic insane back from state institutions to the care of their relatives.

If this is the case, we shall see another year a considerable increase in the number of insane under public care, owing to the increased accommodations which will be provided in the new county asylums.

I am unable to find any law governing the distribution of insanity in this state, except the one I gave last year, that

the older settled portions of the state have a greater population of insanity than the newer portions. I cannot find that the proportion of native or foreign-born persons seems to affect the proportion of insanity, or that any other of the causes so frequently alleged to be the chief factor in producing insanity, has any considerable influence upon the geographical distribution of insanity in the state.

NOTE: The delay in the publication of the proceedings gives me opportunity to give the numbers of the insane under public care on September 30, 1883. The three years show as follows:

Number of insane under public care in 1881	1,773
Number of insane under public care in 1882	1,913
Number of insane under public care in 1883	2,075
Net increase from 1881 to 1882	140
Net increase from 1882 to 1883	162

As was predicted above, the increased accommodations for the insane provided by the new county asylums, opened in the year 1883, have caused an apparent increase of insanity in addition to the real increase. The real increase, however, has been large.

THE PRIMITIVE DEMOCRACY OF THE GERMANS.*

By W. F. ALLEN, Professor of Latin and History, University of Wisconsin.

The political institutions of the ancient Germans, as described by Tacitus, are of an essentially democratic character. Some of their nations have kings, but royalty is not a necessary part of their constitution, for many nations have no king, and where there is one, he is not invested with any very positive or absolute powers.† Nobles are frequently mentioned, but special privileges or powers are never ascribed to the nobility, and, so far as appears from the in-

*This paper is composed of two papers; one, upon the village community system, read at the meeting of the Academy in 1881; the other at the meeting in 1883. Being properly supplementary to one another, they have been united, and the discussion of both papers brought down to the date of publication.

† *Nec regibus libera aut infinita potestas* Tac. Germ. 7.

formation in our possession, it was a social rather than a political aristocracy. There are serfs, but we are absolutely without information as to their origin or their relative numbers — whether they are Germans, who have sunk from a condition of freedom, or the remnants of a conquered race; whether they are few or many. We cannot, of course, expect to find organized government of the modern type, or any precise definition of powers; but so far as we are warranted in any positive conclusion upon the subject, we may say that the sovereign power was in the hands of the whole people, acting collectively, meeting in a general assembly at stated intervals. (Tac. Germ. 11–12.) The people, in their family organizations, also compose the army;* from a comparison of Tacitus with Cæsar,† an earlier writer, we have a right to infer that these same family organizations live in common occupation of independent districts of land. There are magistrates, holding their office it would seem for life, elected by the people in their national assembly, and acting as a board of administration in the intervals between the meetings of assembly,‡ but also having each his own district where he presides over the adminstration of justice. ‖ From other authorities we know that in this district administration of justice the magistrates only preside; the verdict is rendered by the people of the district in an assembly of the district.

This is a thoroughly republican constitution of society, and this sketch, which rests in every detail upon positive statements of Tacitus, supplemented in only two instances by evidence from other but equally unimpeachable authority, justifies us in the statement that the political institutions of

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* *Non casus nec fortuita conglobatio turmam aut cuneum facit, sed familiae et propinquitates.* (Tac. Germ. 7.)

† *Magistratus ac principes in annos singulos gentibus cognationibusque hominum quantum et quo loco visum est agri attribuunt.* B. G. vi. 22.

‡ *De minoribus rebus principes consultant, de majoribus omnes,* Tac. Germ. 11.

‖ *Principes qui jura per pagos vicosque reddunt.* id. 12.—*Principes regionum atque pagorum inter suos jus dicunt controversiasque minuunt.* Cæs. B. G. vi. 23.

the primitive Germans were essentially democratic. This is also the conclusion at which we should arrive by the analogy of other primitive peoples, especially those of the Indo-European family. Most of them established a kingly office, most of them had slaves, or serfs, or imperfectly qualified citizens to whom they stood in the relation of a ruling aristocracy; but as a rule all authority is regarded as emanating from the body of the citizens.

There was, however, an institution of the Germans, not inconsistent in its original character with the democratic theory of their institutions, which, nevertheless, must have interfered materially with the democratic working of these institutions, and which in the end effected a complete revolution in them of a strongly aristocratic character. This was the so-called *comitatus*, the body of personal followers. It appears to have been of relatively recent origin, for as Cæsar describes it,* it was quite imperfectly developed, consisting simply in the custom of voluntary leaders in times of war, around whom gathered a group of voluntary followers, the relation apparently continuing only for the period of the war. In the time of Tacitus, one hundred and fifty years later, it has been converted from a *custom* into an *institution;* the relation is a permanent one. The followers live at the expense of their chief in peace as well as war.† There are grades in dignity among them, and the several chiefs emulously rival one another in the number and prowess of their followers.‡

Both Cæsar and Tacitus use the word *princeps*, "chief," to designate the leader of the *comitatus*, and this is the same word which is used by both writers to designate also the permanent magistrates who have been already described. The question has naturally arisen, and has been debated with

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* *Ubi quis ex principibus in concilio dixit se ducem fore, qui sequi velint profiteantur, consurgunt ii, etc.* Cæs. B. G. vi. 23.

† *Epulae et quamquam incompti largi tamen apparatus pro stipendiis cedunt.* Tac. Germ. 14.

‡ *Gradus quin etiam et ipse comitatus habet judicio ejus quem sectantur; magnaque et comitum aemulatio, quibus primus apud principem suum locus, et principum cui plurimi et acerrimi comites.* Id. 13.

considerable warmth, whether the right of entertaining a *comitatus* was confined to the magistrates or chiefs of the state. Some have held that any person who chose might gather about him a body of followers; others, on the other hand, have taken *principes* in this relation to mean "nobles," and have regarded the right as a privilege of nobility. I have already said that neither Cæsar nor Tacitus ascribes any political privileges to the nobility, which appears, therefore, to have been a purely social distinction; and this statement is correct, if we take only the terms *nobiles* or *proceres* to mean "nobles," they being the words regularly used in this sense. The word *principes*, on the other hand, does not properly mean "nobles," but "chiefs" — individuals invested with certain governmental powers. It is purely begging the question to assume that, in relation to the *comitatus* it is used in a different sense from its usual one. But the connection in which the word is used is conclusive upon this point. Both the writers in question speak of the *principes* as magistrates before speaking of them as leaders of the *comitatus;* and in Tacitus the passages follow close upon one another with no interruption. He passes directly from the election and the judicial functions of the *principes* to the description of the *comitatus;* the conclusion is irresistible that the *principes* who maintain the *comitatus* are the same as those who administer the government of the state and preside over the judicial assemblies of the districts.

It will be readily seen that an institution like this, which, as Tacitus says, had a direct interest in war,* must have had a powerful influence in converting a peaceful community of peasants into the turbulent and quarrelsome nation of warriors who invaded and overthrew the Roman empire. But our immediate connection is with the constitutional change which it effected. We see a body of elected magistrates (to use a modern term) holding their office for life, and therefore, virtually irresponsible, administering the government in the intervals between the assemblies, having the administration of justice wholly under their direction and

* *Magnum comitatum non nisi vi belloque tueare.* Germ. 14.

gathering about them a body of armed retainers, whom they support in peace as well as in war, but whose interests are wholly in war. The elected magistrates are to all intents and purposes converted into barons, holding their fellow-countrymen in control by armed force. Moreover, although there is no indication and no likelihood that nobility of birth was a necessary qualification for the office of *princeps*, it was natural that an office of so much power would be filled almost exclusively from the wealthy and distinguished members of the nobility. The *principes* were not nobles as a class, or by any necessity; but as individuals they must in almost every instance have been of noble birth.

We are able, in the light of this condition of things, to interpret the single passage which has appeared to identify the *principes* with the nobles: Tacitus Annals, i. 55, where it is said that Segestes, the friend of the Romans, urged the Roman general Varus, in view of the impending revolt of his countrymen, to put in custody both himself, his rival Arminius, and the rest of the nobles — the common people would venture upon no movement when they had lost their chiefs.*

The *principes* and the *proceres*, in their origin wholly different — the one elected magistrates, the other a social aristocracy — became identified with each other; the office of *princeps* would tend to become hereditary, and the social aristocracy was gradually converted into a political aristocracy.

The primitive and fundamental democracy of the Germans was, therefore, in the time of Tacitus, confronted by a wealthy and powerful official aristocracy, the forerunner of the feudal nobility. By the side of the national army, the organic divisions of which were formed by groups of kindred, there appeared the bands of military followers, fighting under the leadership of their personal chief, who at the same time, in his official capacity, must have commanded also the national host. By the side of the primitive communities of free tribesmen, also composed of family groups, there appeared the baronial residences of the chiefs,

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* *Ut se et Arminium et ceteros proceres vinciret: nihil ausuram plebem principibus amotis.*

like feudal castles among the villages of peasants. Both of these systems, the democratic and the aristocratic, are clearly described in the Germania of Tacitus, the work in which he treats of their institutions from an antiquarian point of view. In his historical works, where the Germans are introduced, we see clearly the aristocracy as the preponderating force. The same appears also in native pictures of Germanic life, like the poem of Beowulf and the Icelandic sagas.

In two books published within the past year by Mr. Frederic Seebohm,* an eminent English writer, and Mr. D. W. Ross,† of Cambridge, Mass., these baronial — or, as Mr. Seebohm prefers to call them, manorial — features of the primitive Germanic constitution are sketched with great learning and cogency. Other writers have emphasized the aristocratic features of this constitution, but to Mr. Seebohm, approaching the subject from an economic rather than a historical point of view, belongs the credit of having first pointed out that the German institutions were working themselves out upon "manorial lines." But, just as the generally accepted democratic theory undervalues the aristocratic elements of German society, so Mr. Seebohm appears to undervalue its democratic elements. To him the German institutions appear to have been fundamentally aristocratic, while the sketch given above represents the aristocratic features as a relatively late outgrowth.

The argument of Mr. Seebohm and Mr. Ross, is founded principally upon a passage in the Germania of Tacitus (Chap. 16), which we will now proceed to consider. It is as follows: "They dwell separate and scattered, as a fountain, a plain, or a grove catches their fancy. They build their villages, not like ours, with houses touching one another, but each house has a space about it."‡ Here are two modes of habitation described — that of villages, and that of iso-

* English Village Communities. London. Longmans & Co.

† Early History of Land-holding Among the Germans. Boston. Soule & Bugbee.

‡ *Colunt discreti ac diversi, ut fons, ut campus, ut nemus placuit. Vicos locant non in nostrum morem conexis et cohaerentibus aedificiis; suam quisque domum spatio circumdat.*

lated homesteads. The passage, like most passages in ancient works, has been variously interpreted; the interpretation of Mr. Seebohm and Mr. Ross is, that the method first described is that followed by the free tribesmen, and that the villages are of their serfs. This very ingenious theory leaves the democratic features of the German institutions wholly out of account. It represents the free tribesmen as petty barons, each with his village of serfs, and of necessity assumes the free tribesmen to have been a relatively small number of nobles ruling over a large conquered or subject population. It explains half the facts in the case, but leaves the other half unaccounted for, — and this not only in the antiquarian statements of the Germania, but also in the incidental mention in the historians, poets and writers of sagas. For while, as has been already remarked, the aristocratic character appears very strongly in these works, it is no less apparent that the free tribesmen are a numerous, homogeneous body, inferior in wealth and influence, but equally qualified members of the state.

Again, the language of Tacitus does not warrant any so broad contrast between the dwellers in the isolated homesteads, and those in the villages. Mr. Seebohm remarks, (p. 339), that "It is obvious that the Germans who chose to live scattered about the country sides, as spring, plain or grove attracted them, were not the villagers who had spaces round their houses." This we may admit; but when he adds: "We are left to conclude that the first class were the chiefs and the free tribesmen, . . . while the latter, the villagers, must chiefly have been their servile dependents," the inference is not so clear. It would seem that if Tacitus had meant to distinguish not individuals but classes, and especially if he had meant that the one class were chiefs and the other their servile dependents, he would have said so in plain terms. The two kinds of residence are so coupled together, that the only natural inference is that they were alike the residences of the free Germans of whom he is speaking. They are his subject throughout the early part of his work; it is not until he is nearly through with speaking of them,

in the 25th chapter — eight chapters later than the passage under discussion — that he mentions the serfs.

We must conclude, therefore, that the free tribesmen lived in villages as well as in isolated homesteads; and this conclusion is supported by the incidental mention of villages in other relations: for example, in the first book of the Annals, chapter 56, in an invasion of the German territory by Germanicus, Tacitus says that the Germans scattered into the woods, leaving their districts and villages, *amissis pagis vicisque.* If then, some of the free Germans inhabited villages, while others inhabited isolated homesteads; if, further, some of the free Germans fought in companies by family groups, while others followed personal chieftains; and if these personal chieftains were at the same time really noblemen and public officers, it seems probable that it was these chieftains who lived in isolated homesteads, surrounded by their free retainers and their serfs — just as is assumed by Mr. Seebohm and Mr. Ross — while the common freemen, a class ignored by their theory, lived in other villages.

Assuming, then, that the common freemen of the Germans lived in villages, the question arises, what kind of villages were they, and what was the nature of their occupation? In other words, are we warranted in assuming the existence of free village communities among the Germans of Cæsar and Tacitus, as is done by many modern writers. The evidence as to this point is very scanty, being confined to a few isolated statements of these writers, but it is, I think, sufficient to warrant a positive conclusion, partly affirmative, partly negative.

We must begin by defining our terms. The village community is a group of persons occupying a tract of land, which they own and cultivate in common. For the purpose of this common cultivation they must have their residences near together, in a village, from which the arable lands, the meadows, pasture and wood land will be equally accessible to all. The view of the German writers, Von Maurer, Thudichum and others, who have worked up the theory of village communities, is that some communities, *Markgenossenschaften* had such villages, and others not. It is only

those that had them that formed *Dorfgenossenschaften* or village communities proper; and they hold that this was the prevalent form of the occupation of land in the countries occupied by Germanic nations in the early middle ages. The land being owned in common, all members of the community were, originally at least, equal partners; a democratic structure of society is therefore necessarily taken for granted by the theory.

As time went on, individual property in land came into existence. The lands were divided up — the lots occupied by individual marksmen became their property; first the house-lot, then the strip of arable land, became the subject of individual ownership, and when this had taken place, the entire aggregate belonging to one member of the community — house-lot. share of arable land, and right to the pasture, forest, etc. — was called in English, *hide*. Every member, therefore, of the primitive democracy, had an equal property at the outset. The irregularities in wealth and station were the outgrowth of the natural workings of competitive relations in the more advanced state of society.

The question of village communities is essentially a question of the occupation of land, and its theory stands in the closest connection with the history of the origin of the feudal tenure of land. It necessarily involves, moreover, the discussion of another subject, which may be treated independently in other historical epochs, but which in the early history of institutions is inextricably connected with that of land — the structure of society. The reason of this is that, whereas in modern society the state, or political organization, starts with a given territory, and embraces all occupants of that territory; in ancient society it was exactly the reverse. The tribe or nation was the starting point, a given body of persons; and the state — if we may use this expression for this period — comprised whatever territory was occupied by these persons. We see survivals of this primitive condition of things in the tribal organization of our North American Indians. Although occupants of part of the territory comprised within the limits of the United States, they are, nevertheless, not recognized as belonging to that nation, for the reason that they

keep up their tribal organization, with a *quasi* authority over the lands assigned to them by the national government.

The structure of society forms, therefore, the first subject of inquiry in the history of early institutions. And here we notice a still more fundamental contrast with modern society. Modern society, at least here in the United States, has no structure at all beyond the loose institution of the *family;* apart from these petty communities our society is composed simply of individuals with no organic connection with one another, except such as grows out of political relations or private association. But all early societies are highly organized and closely coherent. The man does not exist except as a member of an organization. Any person who stands outside of the organization is in the strictest sense of the term an outlaw. The structure of society must, therefore, be sought first, and the land system will necessarily be an outgrowth of that.

I will first examine the earliest writer, Cæsar, by himself, then see how far the statements of Tacitus agree with those of Cæsar, and what system of society and land tenure may be assumed for both periods.

It has become a common place of political history that early society was founded upon the Family; or, if we go back to the rudest beginnings, where the Family as an institution did not exist, upon Kinship. That this was the case among the ancient Germans, and that the occupation of the land was based upon the family, is testified to in the most positive manner by Cæsar (B. G. vi. 22), where he says that the lands are assigned by the magistrates to the several clans and kindreds of men (*gentibus cognationibusque hominum*). This assignment, he adds, is made for a year at a time (*in annos singulos*), and that it is made at a public gathering, appears to follow from the words *qui una coierunt,* "who have assembled together," where the relative must refer to *hominum,* "men." Among the reasons mentioned for this custom of annual division is the significant one that thus they are able to maintain an equality of possessions (*cum suas quisque opes cum potentissimis aequari videat,* "each one of the community seeing his own possessions

equal to those of the most powerful"). This fact is further emphasized by the statement that no one has land of his own (*neque quisquam agri modum certum aut fines habet proprios*); and he adds that this annual shifting is imperative and under the direction of the government (*anno post alio transire cogunt*). These last statements are found also in the description of the Suevi (iv. 1); *privati ac separati agri apud eos nihil est, neque longius anno remanere uno in loco incolendi causa licet.* "There is among them no private and individual land, nor are they allowed to remain longer than a year in one place for the purpose of habitation."

In these few clear and positive statements Cæsar gives us the materials for determining precisely the stage of social progress reached by the Germans of his time. They were still in the patriarchal stage, in which kinship rather than territory formed the basis of their organization; but they had passed beyond the stage of nomadic life. The individual had no permanent home, neither had the family, but the nation had. More than this, it would appear that there were already certain fixed and determinate territorial divisions of the territory of the nation, for the assignments of land are made with absolute authority by the magistrates, who assign lands and compel the annual changes; and these magistrates, as we learn from Chap. 23, have authority over territorial districts (*principes regionum atque pagorum*). From this we may infer that the shiftings of occupation were made rigidly under the direction of the magistrates, and within the limits of definite territorial districts. Thus Horace (Od. iii, 24, 12) says of the Getæ, a Germanic people:

Immetata quibus jugera liberas
Fruges et Cererem ferunt.
Nec cultura placet longior annua,
Defunctumque laboribus
Æquali recreat sorte vicarius.

Here are clearly indicated the shifting annual occupation, and the lack of any permanent boundaries to the cultivated fields — no ownership, but temporary occupation and use; perhaps also the alternation of agriculture and service in the field, described by Cæsar, B. G., iv. 1. *Singula millia*

armatorum bellandi causa ex finibus educunt. Reliqui qui domi manserunt se atque illos alunt. Hi rursus in vicem anno post in armis sunt, illi domi remanent.

Passing now to the account given by Tacitus, who lived about one hundred and fifty years later, we find that his description partly confirms and partly supplements that of Cæsar; that it nowhere contradicts it, but in some points shows the changes which might reasonably be expected to take place in the course of a century and a half, among a semi-barbarous, but vigorous and intelligent people, in direct contact and constant intercourse with a highly civilized nation.

As to the structure of society, Tacitus testifies, just as Cæsar does, to the persistence of the family principle; only he mentions it in connection with the military organization, instead of the occupation of land (Germ. ch. 7.); *non casus nec fortuita conglobatio turmam aut cuneum facit, sed familiae et propinquitates.* "Their divisions of cavalry and infantry are not made up by chance or accidental assembling, but by families and neighborhoods"— the same patriarchal groups no doubt, which are described by Cæsar's *gentibus cognationibusque.* The two statements naturally form the complement to each other; if patriarchal groups lived together as Cæsar says, they naturally formed military divisions together, as Tacitus says.

Tacitus does not tell us that the patriarchal groups lived together, but it may be inferred that this was the case, from the fact that they fought side by side. When he takes up the subject of the occupation of land (Chap. 26), he merely speaks of the land being occupied by communities, *ab universis.* The passage is so important and so difficult to interpret, that I will cite it at length: *Agri pro numero cultorum ab universis in vices occupantur, quos mox inter se secundum dignationem partiuntur; facilitatem partiendi camporum spatia praestant. Arva per annos mutant, et superest ager.* "It is their practice to have their lands taken into possession by communities, turn by turn, in amounts proportioned to the numbers of their members, and afterwards to share these out among the members ac-

cording to rank; the wide extent of the tracts occupied makes this division easy. They change the fields in cultivation every year, and there is land left over."

Here we have, just as in Cæsar's description, a periodical shifting of occupation, and this is the only feature of the two descriptions which we identify positively. For the reasons already given, we may infer that these communities, like those of Cæsar's time, were patriarchal, at least prevailingly so; but the distribution was probably no longer a yearly one. It will be noticed that two distinct procedures are described — the shifting occupation (*agri . . . occupantur*) and the shifting cultivation (*arva per annos mutant*). It is hardly possible that there could have been any shifting cultivation, that is, rotation of crops, unless the occupation was for more than one year. I think, therefore, that although not explicitly stated, it is distinctly implied, that the assignment of lands was made for a period of years, as is the case with the Russian *Mir* and the Hebrew seven-years' period. This points to a marked progress of society in the period between Cæsar and Tacitus.

In another point this progress is more positively asserted We have seen that in Cæsar's time there was not only no private property in land, but no disparity in property or in occupation. Tacitus, on the other hand, states with equal positiveness that the lands were assigned according to rank, *secundum dignationem*, that is, there was still no private property in land, but the amount of land temporarily assigned to individuals varied according to their rank. This disparity probably had reference only to the nobles and magistrates; the most of the common freemen in all likelihood received equal lots. And when, at the end of the period, the community was transferred to another tract of land, the process was begun over again. There could therefore be no aggregations of landed property, but there was a condition of things out of which such aggregations might easily grow, as soon as the occupation of a definite tract of land by a particular community should become permanent.

We find from this analysis, that in the first century after Christ, the Germans were grouped in family communities, not

yet established in permanent homes, but probably changing their residences at intervals of some years, although always within a definite territorial district. This district was, as we learn from the same authority, a permanent political institution. It follows as a matter of course that at this period there was not only no private property in land, but no common property in land, that is, no property in land at all. Neither the community nor the family *owned* the land or occupied it personally, any more than the individual. It might perhaps be urged that the district owned the territory within which the shifting occupation took place, but it may be doubted whether even this would be a correct statement of the facts. Property in land was probably a conception which lay wholly outside of their imagination as well as their experience. The land, like the air, was a free gift of nature, to be used in common, but with no thought of ownership.

As the theory of the village community implies not merely permanent occupation, but ownership of the land, on the part of the group of occupants, our conclusion must be that the village community did not exist in the time of Tacitus. Nevertheless, it must be admitted, on the other hand, that the condition of things here described is one out of which the village community could very easily have arisen. In the fact that the distribution was periodical instead of annual, we see a movement towards permanence of occupation, and therefore towards ownership, on the part of the community. The time would very soon come, in the progress of society, when the community would have accumulated so much fixed wealth in the course of its occupation, that it would be a hardship and an injustice to force it to change its habitation. The next change therefore — hardly a greater change than that from annual to periodical re-distribution — would be to convert the temporary occupancy into permanent occupancy, which means property. If this stage was reached — and it is hard to conceive of its not being reached, at least as a temporary condition of things — there resulted to village community: that is, the ownership in common of

a definite tract of land by a group of persons who were in their origin an enlarged family.

By the side of the movement towards permanency of occupation, we saw another, towards inequality of possession. The important testimony of Tacitus shows that already in his time there was, not individual property in land, or inequality of ownership, but inequality of station and of temporary occupation. Out of this would speedily be developed the inequality of property which the theory of village communities recognizes as one of the causes of the dissolution of the institution. And thus we find confirmed, from the point of view of the occupation of land, the conclusion drawn from the evidence of political and military institutions, of the development of an aristocracy of a baronial type; or, in Mr. Seebohm's words, of development on manorial lines.

NOTES ON THE DISPERSION OF DRIFT COPPER.

By Prof. R. D. Salisbury, Beloit, Wis.

Although the fact of its wide distribution has long been known, and used as evidence of the northern origin of our drift, yet no general recent compilation of the known data relating to the dispersion of drift copper seems to have been made. The study now entered upon has been undertaken at the suggestion of Prof. Chamberlin. The present paper is little more than a collection of what is to be found bearing on the subject in survey reports and scientific contributions. Frequent reference is made in geological literature to the fact that native copper has been found, and that quite generally, scattered throughout the drift region of the interior, viz.: Ohio, Indiana, Illinois, Missouri, Iowa, Michigan, Wisconsin and Minnesota, and perhaps Nebraska and Dakota. But the particulars of its occurrence, e. g., its exact localities, the size of specimens, whether or not worn and rounded, what the limits of its distribution, how abundantly the metal

is found in the formation in which it occurs, whether it is uniformly scattered, or whether there is grouping in the dispersion, whether it is in lacustrine or true drift deposits, and if in the latter, whether in modified or unmodified drift; these particulars are rarely given. An attempt to bring together and map what can be obtained from the survey reports of the several states, at once reveals the fact that the observations on this subject have been of an extremely general character. The following compilation is believed to include essentially all that has been printed, bearing on the subject.

In Ohio, Col. Whittlesey[1] has noted a specimen from Weymouth, Medina county, thirty miles south from Lake Erie. This, so far as is known, marks the eastern limit of the dispersion of copper. Again, in Clermont county, Prof. Orton, of the Ohio Survey,[2] notes the occasional occurrence of fragments of copper in the bowlder clay. Reference is also made in the Ohio reports,[3] to the frequent occurrence of copper in the drift of the northwestern part of the state, but no localities, or details as to its occurrence are given.

In Indiana, R. B. Warder, of the Indiana Survey,[4] notes a specimen found at Weisburg, in Dearborn county, on Tanner's Creek, weighing twenty-six ounces. Other specimens also have been found in the adjacent counties, Ohio and Switzerland. Still farther down, in the southwest corner of the state, in Vanderberg county, small fragments have been noted by Prof. Collett,[5] and a little to the north, the same authority notes small specimens from Knox and Brown counties. In Warren county, larger nuggets have been found, and Prof. E. T. Cox[6] is authority for the statement that some large pieces and many small ones have been found in the drift both of northern and southern Indiana.

[1] Smithsonian Contributions: On Fresh Water Glacial Drift of the Northwestern States.

[2] Vol. I, p. 441.

[3] Vol. I, p. 87.

[4] Indiana Geological Report, 1872, p. 403.

[5] Geological Survey, 1875, p. 284.

[6] Geological Report, 1878, p. 117.

Of the copper in Illinois we have somewhat fuller notes, though not more detailed. In this state, drift copper reaches its southern limit, so far as now known. In Saline county, near Gallatin, latitude 37° 40′, a nugget "larger than a hen's egg," with not infrequent smaller ones, have been found by Dr. Smith, and noted by Prof. E. T. Cox, then of the Illinois Survey, in the beds of streams and in ravines.[1] The same is true of Hamilton county, lying just north.

Prof. Worthen has noted the existence of copper in the drift of Clark and Cumberland counties,[2] and Mr. F. H. Bradley in Edgar, Champaign and Ford counties, lying just to the north. In Vermillion county, still further north, the same authority[3] says that several large masses of copper, and many small ones have been taken from the upper drift beds. The occurrence of copper in Hancock, Adams, Brown[4] and Schuyler[5] counties has also been noted by Prof. Worthen; and in Stephenson and Winnebago counties, where the nuggets are spoken of as much worn and rounded, and Boone, Ogle and Lee counties,[6] by James Shaw, of the Illinois survey. Woodford[7] and La Salle counties, have also yielded specimens of "float mineral," as noted by H. A. Greene. In Will county, a specimen of considerable size was found near Wilmington, probably in a lacustrine formation, while many smaller ones have been discovered both here and in Cook county.[8]

The dotted area on the map represents the area of the copper-bearing series, essentially as determined by Prof. R. D. Irving.. The drift copper is represented by dots, located as exactly as the data at hand will permit. No attempt is made to show the relative sizes of the different pieces. Where the statement has been made that "float copper" is frequently found in a certain county, several dots have been placed within the limits of such county. Where but a single find has been authoritatively reported from a given district, the fact is indicated by a single dot.

[1] Vol. I, Illinois Geological Report, p. 232.
[2] Ibid., vol. VI, pp. 10 and 98.
[3] Ibid., vol. IV, p. 244.
[4] Ibid., vol. IV, p. 65.
[5] Ibid., vol. IV, p. 77.
[6] Ibid., Vol. V.
[7] Ibid., Vol. IV.
[8] F. H. Bradley, ibid., vol. IV.

In Missouri, specimens, on the authority of G. C. Broadhead, State Geologist, have been found in the eastern part of Putnam county.[1]

In Iowa, Dr. White has noted the occurence of copper in various parts of the state, and a single bowlder mass weighing upward of 30 pounds, has been taken from the drift in Lucas county.[2] In Lee and Henry counties, the occurrence of the metal in question is recorded by Prof. Worthen.[3]

In Minnesota, copper has been found in Fillmore county,[4] and at Pleasant Grove, in Olmstead county. In a description of Travers county, Mr. J. O. Barrett, speaks of its occurrence, but his language is somewhat ambiguous, and it is uncertain whether the copper referred to belongs to the county under description, or to the coteau in the adjacent part of Dakota.

Prof. G. D. Swezey, of Doane College, Nebraska, informs me that it is current report that copper has been found in small fragments in Nebraska, but he is unable to give localities.

In Michigan, a mass of copper was found at Northport, Leelenaw county, which was sold for $80, and hence must have been of great size. In Benzie, Antrim and Grand Traverse counties also, copper has been frequently met with. Col. Whittlesey speaks of a specimen the size of a man's fist, from Ada, Kent county, with frequent smaller fragments.

In Wisconsin, Dr. Lapham says[5] that in the form of drift bowlders copper is often found in eastern Wisconsin, the masses varying from a few ounces to several hundred pounds. The largest, near Huntsford, in Dodge county, had a weight of four hundred and eighty seven pounds. Prof. Chamberlin[6] states that copper is frequently found at all points along the Kettle range.

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[1] Geological Survey of Missouri. p. 289.

[2] Vol. I, Geological Survey of Iowa, 1870, p. 96.

[3] Geological Report of Iowa, 1878, p. 178.

[4] N. H. Winchell's Report of 1875, p. 71.

[5] Wisconsin Geological Report, vol. 2, p. 27.

[6] Geological Report of Wisconsin, vol. 2, p. 210.

Prof. Irving[1] says further that fragments of copper are far more abundant in Wisconsin than elsewhere, and far more abundant here than has been commonly supposed, and that specimens of forty to fifty pounds weight are not uncommon, and have been made of economic use. It is stated by E. T. Sweet,[2] on the authority of Mr. S. Vaughan, that a copper bowlder of seventeen hundred pounds weight was formerly taken from the bed of the Sioux river, six miles south of Lake Superior, and that a bowlder of one hundred pounds weight was taken from Outer Island only a few years ago.

Col. Whittlesey[3] speaks of the copper drift in Wisconsin and northern Michigan as follows: "A copper rock weighing three thousand pounds was found in the red clay on the west fork of the Ontonagon river. One was found in 1845, opposite La Pointe, on the mainland, weighing eight hundred pounds. Three miles south of the Minnesota Mine on middle fork of the Ontonagon, another copper bowlder was taken from the red clay, which weighed between three and four hundred pounds. In a well in Madison one was found at a depth of twenty feet, having a weight of thirty pounds." At the mouth of the Menominee river a chunk three or four pounds in weight has been found, and another at the mouth of the Oconto of about the same size, while a much larger piece was taken from the Pesaukie river. In Walworth county, near the state line, Col. Whittlesey also notes a boulder of forty or fifty pounds weight. Copper has also been noticed from Ripon and Kenosha in gravel beds. In addition to these occurrences cited by Col. Whittlesey, Prof. Chamberlin has had record of about thirty specimens from Walworth county. Aside from these, one was recently found at Geneva Lake which weighed upward of seven pounds. Prof. Chamberlin is authority for the statement that a specimen of one hundred and fourteen pounds weight was taken from Newark, Rock county. This bowlder had also attached to it fragments of Lake Superior Keweenawan

[1] Wisconsin Geological Report, vol. 2, p. 619.

[2] Wisconsin Geological Report, vol 4, p. 353.

[3] Smithsonian Contributions, 1866.

rock. In Sauk and Chippewa counties, on the same authority, specimens have been found. I have picked up two specimens of copper on the shore of Lake Michigan in Ozaukee county, after a severe storm during which they were probably washed from the red clay, which there borders the lake. These specimens were both very irregular, and showed no signs of having been subjected to corrasive action.

The area over which copper is scattered is thus seen to be very great, perhaps not less than 450,000 square miles. If all the fragments came from Lake Superior, some of them must have been transported about 600 miles to the south, others, 150 or 200 miles, or perhaps more, to the west, and small specimens have been carried more than 100 miles east of the eastern limit of the locality from which the copper is supposed to have come. There is then an east-west distribution, accepting the testimony from Nebraska, of more than 700 miles, and a north-south distribution about 100 miles less.

Farther than the fact of its occurrence, however, little at present can be said of the copper in these various localities. Specimens have been found about Lake Superior and along Lake Michigan, both in Wisconsin and Illinois, in lacustrine deposits. Again, specimens have been found in bowlder clay, in lower and upper drift beds, in beds of streams and in ravines. But the character of the deposits in which the copper has been found, has, in by far the larger number of cases, not been indicated more closely than by the statement that it is drift. Pieces have been found both north and south of the kettle moraine, as well as in it. The general fact that these specimens diminish in size southward, seems to be well established, but to this there are some exceptions. Many of the nuggets are worn and rounded, but this does not seem to be universal, for angular fragments, and fragments having the irregular, scraggly form peculiar to this metal, have been found well down in Illinois. What the agency or agencies concerned in this wide spread dispersion is an interesting question. If fuller observations had been made, or if those noted had been more exact—*e. g.*, if the precise character of the formations in which the copper occurs had

been determined in each case, the size, shape and condition of the specimens, and their frequency in any locality, this might give us the data required for explaining the dispersion. There appear to be localities where the copper is more abundant than at others, as at Grand Traverse Bay, at the mouth of the Illinois river, and along the lower course of the Wabash. The seemingly greater abundance at these points, however, may only be due to fuller observation or record of the metal found at these points, and not to its really greater prevalence.

It may not be out of place to call attention to the probable fact that the Illinois river, about whose mouth many specimens have been found, was once the outlet of Lake Michigan, and that the Wabash, about whose lower course much copper has also been found, was the channel for discharge, in post-glacial times, of Lake Erie. It is evident that if the copper were all transported from Lake Superior by glaciers, they must have had, at different periods, very divergent courses to account for the east-west dispersion. The fact that copper has been found in the red clay both of Lake Superior and Lake Michigan, suggests that along the lake borders, pieces of copper may have been dropped by floating ice, and the roughness of at least a portion of the specimens here found, is in harmony with such a view.

There is of course a possibility in all cases, and this possibility may at times amount to probability, that the dispersion of copper has been by human agencies. A single loose specimen, for instance, has been found in the "driftless area" in Jo Daviess county, Illinois, in a rock crevice. But in regions where frequent specimens are found scattered through the drift, there is little probability that their occurrence can be explained by human transportation.

Dr. Bell, of the Canada Survey,[1] has described a formation on Hudson's Bay, which has a strong resemblance to our Keweenawan system. He has indicated his belief that the formation is the equivalent of the Nipigon group, which is supposed to be continuous with the Keweenawan, and, therefore, its equivalent. Dr. Bell describes copper sulphide in the as-

[1] Geological Report, 1878.

sociated formations about the Bay, but does not note native copper, which seems not yet to have been discovered. If it should be found to exist there, this would furnish a second center of dispersion, but as it is nearly north of the Lake Superior region, this would not greatly facilitate the explanation of the extensive east-west dispersion.

Fuller notes, which it is proposed to collect at an early date, will doubtless throw fuller, and, it is to be hoped, important light on the question of the dispersion of drift copper, the agency or agencies by which it was effected, and their method of action, and this solution may in turn have some bearing upon other interesting geological problems.

Since the above notes were presented in 1881, the following additional facts have been secured through the kindness of the parties to whom they are accredited. In *Ohio*, Mr. M. C. Read states that "there is an important belt of drift running through Licking, Knox and Richland counties, in which many fragments of copper have been found." Mr. C. R. Barnes reports from *Indiana*, a specimen weighing 3,125.8 grams, somewhat flattened, from Moot's Creek, White county. Another piece "four inches long by two and one-half broad, and three-fourths of an inch thick, worn smooth," was found "in glacial gravel," in Vermillion county, near Eugene (J. T. Scovell). From the same state, Mr. Joseph Moore gives information of four specimens. One was found near Richmond, Wayne county, weighing 17 oz. Another of two pounds weight was found three miles from Elkhart, Elkhart county. A third piece (mostly carbonate), has been found in Henry county, and a fourth near Brookville, Franklin county. Besides these finds, Mr. Moore also states on the authority of Mr. Farrar, that copper is frequently found about Peru, Miami county, in isolated lumps, also that a piece weighing 30 pounds was found "in shelly limestone, where they were excavating for a road." From *Michigan*, Prof. I. W. McKeever, gives information of a piece of copper from Jackson county, which the finder (Dr. Baker, of Adrian) believed to be of meteoric origin. It is claimed that it was seen while falling, and taken the next day from the opening found in the earth where the meteor was seen

to strike. It was found eight feet below the surface. It is further asserted that "fragments of copper were found all the way down." This interesting specimen is "about two inches thick, having an area of about one square foot. It looked as if it had been melted. There were spots of green carbonate upon it," when seen by Prof. McKeever, but these, he suggests may have formed since it was found. From *Wisconsin*, Mrs. G. W. Esterley, in an article in the *Evening Wisconsin*, reports the finding of a piece of thin, flat copper insinuated among the beds of Trenton limestone, in a quarry near Lake Koshkonong. Prof. Chamberlin reports a similar case of insinuation in Galena limestone near Belvidere, Ill.

Professor H. E. Storrs writes from Jacksonville, *Illinois*, that a fragment of copper was some time since found twenty-five feet below the surface, in digging a well in that city; the same being three inches long by one and one-half broad, and one-fourth of an inch thick. The same gentleman also speaks of two other specimens of copper in his possession, weighing six and one-half ounces, and four pounds, three ounces respectively, the second being "evidently worn in transit." The precise localities of these two specimens is unknown. "A small piece of native copper was found . . . in the city of Alton, . . . in löss," according to Professor Charles Fairman, who also adds that it is locally reported that large bowlders containing copper were formerly found in that locality.

Professor N. H. Winchell, furnishes the following facts concerning drift copper in Minnesota:

State.	County.	Town.	Size of Specimens.	Condition.	Formation
Minnesota	Le Sueur	Le Sueur	?	?	?
Minnesota	Scott	Jordan	?	?	?
Minnesota	Scott	Marian	?	?	?
Minnesota	Hennepin	Minneapolis	3 pounds	Rounded.	Gravel.
Minnesota	Hennepin	Eden Prairie	78 pounds.*		
Minnesota	Olmstead	Rochester	4 ounces	Rounded	Among stones near the rock.
Minnesota	Olmstead	Zumbrota	5 pounds	Rounded and corroded	
Minnesota	Olmstead	Pine Island	¾ pound	Rounded	On surface.
Minnesota	Ramsey	White Bear	2 pounds	Rounded	Near surface
Minnesota	St. Louis and Carlton	Knife Falls to N. Pacific Junc.	Hundreds of pieces.	?	Among stones and rounded bowlders.
Minnesota	Pine	Various places	?	?	?

* Found in a railroad cut,

MAP
SHOWING DISTRIBUTION OF DRIFT COPPER.

ON THE MOTOR GANGLION CELLS OF THE FROG'S SPINAL CORD.

By E. A. Birge, Ph. D., Professor of Zoölogy, University of Wisconsin.

The following paper was originally published in the "Archiv für Anatomie and Physiologie," for 1882. A synopsis of the work is here presented in English.

The reason of our defective knowledge of even the most important numerical relations of the elementary structure of the body lies in the incomplete methods of investigation which were formerly employed. Stilling's attempts to determine the number of the elements of the central nerves system have not been carried further, because the means of investigation were too imperfect to secure certain results even with the greatest care and industry. Rough approximations only were made, which naturally were often incorrect. The enumerations recently made of the fibers of the optic, and of certain spinal nerves have shown that the more perfect methods now at our command, have brought us nearer to accurate results.

The method of saturating the specimens with a substance which binds all parts together and gives them a like consistency, obviates one of the greatest dangers to be found in counting the cells of an organ, viz., the loss or destruction of part of the cells. Further in the possibility of staining specimens *en masse*, in perfect and rapid microtomes, in the accurate arrangement of specimens upon the slide, we have gained means which reduce to the work of a few months, tasks, for which, a decade since, a life-time would not have sufficed.

Two conditions must be fulfilled in the counting of the cells of an organ. The cells must be brought under the microscope without loss, and must be so colored that they can be at once and easily distinguished. If these conditions are met, the enumeration will be easy and quick, as well as trustworthy; but if one must deliberate whether to count certain

elements or not, the process will be exceedingly slow and wearisome, and the result thoroughly untrustworthy. Since our methods of discriminating staining are yet far from perfect, the structures capable of counting are still few. Dr. Gaule, of the Physiological Institute at Leipsic, under whose direction this paper was worked out, called my attention to two structures which filled both the above conditions, and which were of great interest. These were the medullated nerve-fibres of the anterior roots of the spinal nerves, and the large ganglion cells of the anterior horn of the gray matter of the spinal cord. The enumeration was made upon the frog, the most favorable animal, both because of its small size and because of its importance in experimental physiology.

The value of such enumerations as the following depends, of course, entirely upon their accuracy. I have attempted in every way to assure myself of the reliability of my results. The close correspondence of the number of cells found on right and left sides, seems to me the clearest proof of the accuracy of the counting.

The numbers of the elements which I have determined lead to certain conclusions, apart from any theoretical considerations. 1. The frog has an equal number of cells in the anterior horn of the spinal cord, and of fibres in the anterior roots of the nerves. Each motor cell, then, corresponds to a motor fibre. 2. There is a general correspondence between the number of cells in any region of the spinal cord and of fibres entering that region. When an individual frog shows peculiarities of distribution of fibres to different nerves there is a corresponding peculiarity in the distribution of the motor cells. It is thus probable that the ganglion cell belonging to a particular fibre lies not far from its entrance to the cord. 3. The number of fibres and cells varies with the weight of the frog. Each frog starts with a certain minimum number which is regularly increased with the increase in weight. Hence (a) the fibres and cells must be constructed during the life of the frog; (b) a certain relation obtains between the weight of the muscles and the number of the motor fibres and cells.

I. Number of Motor Fibres.

The roots were treated *in situ* with osmic acid, one per cent., for two to six hours, and imbedded in paraffine. The sections must not be over 1-100 mm. thick, better 1-200 mm., since if the axis of the fibre is not exactly perpendicular to the section the light will not pass through it unless the cylinder is very short. If the fibres overlie each other, or if they are so long that their obliquity cuts off the light, rapid and accurate counting is out of the question.

The counting was performed with an eye-piece micrometer divided into squares. Some counts were made with the camera lucida, marking each fibre by a pencil dot. This was a less accurate method. All nerves were counted twice, and the work was repeated if the difference was over two per cent.

The results are shown as follows:

TABLE I.

Number of frog	49	46	41	36	40	43	42
Weight in grammes	1½	9½	23	63	67	87	111
Motor fibres on one side.	2,992	3,209	3,529	4,283	4,746	5,002	5,734
Total motor fibres	5,984	6,418	7,058	8,566	9,492	10,004	11,468

The total number is reached by doubling the number obtained on one side. As will be seen later in the section on ganglion cells the number is the same on the two sides.

A somewhat regular increase of fibers proportionally to the increase of weight is seen:

TABLE II.

Frog	49	46	41	36	40	43	42
Increase of weight	.....	8	21.5	61.5	65.5	85.5	109.5
Increase of fibres.....	.....	497	1,064	2,582	3,508	4,020	5,484
Fibres per gram. of increase	.....	62	50	42	53	47	50

From this table it becomes possible to compute *a priori* the approximate number of fibres, at least for Rana esculenta. The addition of fifty fibres for each gramme in weight to the fixed number 6,000 will come near the required result. The female frogs must be weighed without ovaries.

How does this increase in number of fibres take place? It may come either by division of fibres previously present, or by new formation. The latter method is on all grounds more probable. The relative size of fibres in young and old frogs forbids us to think of division as the process, since in young frogs the fibres are of far smaller average size. This is shown by the number of fibres which stand in a given area, as the following table exhibits:

TABLE III.

	Frog 49, w't 1½ grm.	4 23 grm.	36 63 gr.
Area of cross section of 2d motor root.. .	0.046 sq. mm	0.105	0.125
No. of fibres	968	1098	975
Fibres per sq. mm.....	21,434	10,457	7,800

Hence the fibres in the smallest frog had hardly one-third the area of those in the larger frog. The large fibres in both are about the same size, but there are in the smaller frogs a vast number of minute fibres. There are also, probably, others not yet medullated and hence not rendered visible by osmic acid, which develop into the new nerve fibres of the older frogs.

The size of the fibres is by no means the same in the different nerves of the same frog as the following table will show:

TABLE IV.

Frog No. 36 — Wt. 63 grm.

Nerve.	I	II	III	IV	V	VI	VII	VIII	IX	X
Area of mot'r root in sq. mm.....	0.087	0.125	0.052	0.018	0.024	0.02 26	0.04	0.152	0.067	0.015
No. of fibres.....	783	975	481	106	114	159	142	870	441	212
Fibres per sq. mm	9000	7800	9257	5888	4750	7035	3550	5723	6582	14133

The differences are obvious, and unquestionably depend on the function of the nerves. The first three nerves, which supply the tongue, forward extremity, etc., have an area of

0.264 sq. mm., with 2,239 fibres, while the seventh, eighth, ninth nerves which supply the lumbar plexus, have an area of 0.259 sq. mm., with only 1,453 fibres, that is, with approximately the same area, there are only two-thirds as many fibres. The fourth, fifth and sixth nerves stand in size of fibres between the two groups, while the tenth nerve has the smallest fibres, possibly since it contains those which supply the lymph hearts.

Since the muscle fibres of the hind legs are so much larger than those of the fore legs one cannot help thinking that there is a relation between size of motor fibres and the muscle fibres supplied by them. But this question needs further investigation.

Another striking fact, like that of the size, and found also in the ganglion cells, is that of the number of fibres in brachial and lumbar plexus respectively. In spite of the smaller size of the anterior extremities they receive an equal or greater number of nerve fibres than do the hind limbs. These facts will become more apparent by the following table:

TABLE V — MOTOR FIBRES.

Number	49	46	41	36	40	43	42
Sex.....	—	♀	♂	♀	♀	♂	♀
Wt. in gram.	1½	9½	23	63	67	87	111
Nerve. I	359	416	652	783	754	653	1023
II	986	764	1098	975	1051	1397	1256
III	151	574	226	481	559	767	788
IV	142	155	119	106	187	146	117
V	79	96	92	114	102	118	106
VI	110	116	137	159	127	96	236
VII	135	123	137	142	162	112	141
VIII	583	309	501	870	967	446	515
IX	383	593	450	441	631	755	1248
X	64	63	112	212	206	602	310
Sum.	2992	3209	3524	4283	4746	5002	5134

The table shows that considerable individual differences are present. In No. 36 the 8th nerve has twice as many fibres as the 9th. In No. 42 the relation is reversed. Usually the 6th nerve is larger than the 5th, but occasionally the 5th is the larger, etc. The relations are more regular when groups of nerves are considered. If we neglect the contribution of the 1st nerve to the brachial plexus and that of the 10th nerve to the lumbar plexus, we have:

TABLE VI.

Number.....	49	46	41	36	40	43	42
Plexus brachialis.....	1,237	1,338	1,304	1,456	1,710	2,074	2,038
Plexus lumbalis	1,101	1,025	1,088	1,453	1,760	1,413	1,904

The brachial plexus contains at least as many fibres as the lumbar, and the relative size would be still more striking if the parts of the 1st and 10th nerves were assigned to their respective places.

The variation in individual nerves appears most plainly in the hinder half of the cord, and is very probably due to the relation of points of exit of nerve from cord and spinal column. When a nerve fibre has considerable distance to travel before leaving the spinal canal, it makes little difference whether it leaves the cord in one or another root. It is only necessary that it gain the proper nerve-trunk and this is determined by the plexus.

II. The Motor Ganglion Cells of the Spinal Cord.

The cords whose cells were to be counted were stained in Grenacher's alum carmine, imbedded in paraffine, and the sections cut of a uniform thickness, usually 1-50 mm. They were mounted in order and covered with xylol balsam. In this method the nerve fibres are little stained, while numerous granules and ganglion cells are tinged with a more or less deep red. In the anterior horn of the gray matter lies the group of closely-joined, large motor cells whose number is to be determined. The only difficulty in counting

lies in the presence of a number of small ganglion cells, apparently belonging to the motor center, but whose small size makes them hardly distinguishable from the "granules" of the cord. In the first frogs investigated, these cells were not counted. Later it was found that they belong to the small motor fibres and they were enumerated. In frog number eighteen, whose large cells only were first counted, the small cells were afterwards determined and about six hundred were found on each side.

The number of cells in the motor group varies in each section from 2–3 to 25–30, according to its thickness and the region of the cord to which it belonged. Single, very thin sections from the center of the cord, occasionally contain no cells.

There is no difficulty in determining with fair accuracy the number of cells, if all mechanical aids are employed, so that individual attention can be given to counting. One source or error, however, cannot be avoided. There is no natural limit to the motor center toward the medulla oblongata, but the cord gradually passes into that structure. The only fixed point is that where the spinal canal opens into the fourth ventricle, and this arbitrary line was chosen as the only one which could be determined. The following table gives the result of the counting.

TABLE VII.

Number of frog.	Total number of cells.	Right.	Left.	Difference.	Per cent. of difference.
49	4,871	2,457	2,414	43	1.8
18	6,760	3,385	3,375	10	0.3
12	6,892	3,424	3,468	44	1.3
39	8,539	4,272	4,267	5	0.1
43	11,517	5,777	5,740	37	0.6
25	11,131	5,567	5,564	3	0.1

The correspondence of the two sides is so close that it might be supposed that the exactness was attained by unconsciously following, on one side of each section, the number

found on the other. This is not the case. The cells lie in small clusters, which are seldom cut in the same position, and hence the number of cells on the two sides of the same section rarely corresponds exactly. It is therefore impossible to be influenced by the preceding counts in such a way as to "force a balance."

I add the complete enumeration of the cells of one frog, No. 43. Sections 1–146 lay in the medulla oblongata.

TABLE VIII. — No. OF CELLS.

No.	Right.		Left.		No.	Right.		Left.	
147	9		11		204	10		8	
8	10		6		5	7		12	
9	8		9		6	11	46	11	48
150	5		7		7	13		9	
1	6	38	6	42	8	7		8	
2	5		3		9	8		8	
3	6		3		210	6		10	
4	3		4		1	11	45	9	44
5	3		3		2	12		12	
6	2	19	1	14	3	11		9	
7	3		4		4	10		11	
8	4		2		5	9		10	
9	2		1		6	8	50	7	49
160	0		4		7	4		8	
1	2	11	2	13	8	11		7	
2	3		2		9	9		8	
3	7		2		220	7		8	
4	6		1		1	10	41	8	39
6	3		2		2	11		7	
6	4	23	7	14	3	7		6	
7	7		1		4	11		8	
8	3		5		5	4		12	
9	3		7		6	8	39	6	39
170	6		4		7	9		8	
1	1	20.	3	20	7′	8		13	
2	3		4		8	11		9	
3	4		2		9	6		10	
4	3		4		230	15	49	15	55
5	6		5		1	9		9	
6	5	21	5	20	2	11		13	
7	2		3		3	7		8	
8	5		3		4	8		6	
9	6		4		5	8	43	13	49
180	6		2		6	11		12	
1	7	26	5	17	7	8		7	
2	6		5		8	13		10	
3	5		5		9	7		7	
4	6		6		240	8	47	6	42
5	6		9		1	9		11	
6	3	26	8	33	2	10		13	
7	4		8		3	9		12	
8	4		5		4	13		5	
9	1		4		5	8	49	20	61
190	3		5		6	21		9	
1	4	16	1	23	7	23		10	
2	3		5		8	18		11	
3	8		6		9	8		12	
4	7		9		250	10	80	16	58
5	10		11		1	11		16	
6	12	40	9	40	2	9		14	
7	6		7		3	17		7	
8	7		10		4	19		14	
9	11		6		5	19	75	11	62
200	9		7		6	12		13	
1	9	42	9	39	7	10		17	
2	10		9		8	13		12	
3	8		8		9	16		19	

TABLE VIII. — NO. OF CELLS — Continued.

No.	Right.		Left.		No.	Right.		Left.	
260	17	68	18	79	315	13	73	19	72
1	13		11		6	14		13	
2	15		17		7	10		12	
3	18		12		8	14		16	
4	15		13		9	13		14	
5	11	72	17	70	320	12	63	7	62
6	15		15		1	15		18	
7	10		11		2	11		12	
8	19		12		3	13		9	
9	12		11		4	18		11	
270	7	63	9	58	5	22	79	15	65
1	12		12		6	16		12	
2	11		12		7	12		15	
3	11		8		8	14		12	
4	7		12		9	13		9	
5	19	60	16	60	330	9	64	12	60
6	8		9		1	17		16	
7	10		11		2	15		18	
8	13		8		3	13		10	
9	15		16		4	8		14	
280	8	54	10	54	5	12	65	12	70
1	14		12		6	23		18	
2	11		10		7	13		11	
3	14		8		8	12		8	
4	11		9		9	17		12	
5	10	60	10	49	340	12	77	18	67
6	12		15		1	13		19	
7	13		21		2	15		11	
8	12		10		3	21		18	
9	19		17		4	16		11	
290	11	67	20	83	5	14	79	13	72
1	12		18		6	19		14	
2	11		12		7	12		16	
3	9		13		8	13		11	
4	9		12		9	12		11	
5	10	51	16	71	350	9	65	12	64
6	15		18		1	15		23	
7	10		17		2	13		11	
8	12		8		3	12		10	
9	10		14		4	11		10	
300	9	56	12	69	5	15	66	14	68
1	17		15		6	15		12	
2	9		10		7	17		15	
3	8		13		8	11		13	
4	12		10		9	10		14	
5	10	56	9	57	360	12	65	8	62
6	9		19		1	13		13	
7	11		16		2	15		11	
8	7		17		3	18		15	
9	12		11		4	9		17	
310	13	52	12	75	5	18	73	13	69
1	13		17		6	9		10	
2	16		12		7	17		12	
3	14		11		8	24		17	
4	17		23		9	22		15	

TABLE VIII. — NO. OF CELLS — Continued.

No.	Right.		Left.		No.	Right.		Left.	
370	12	84	13	67	424	8	34	9	39
1	15		17		5	6		5	
2	14		20		6	7		12	
3	11		13		7	5		3	
4	14		17		8	4		4	
5	10	64	8	75	9	7	30	3	27
6	17		17		430	8		4	
7	11		10		1	5		9	
8	12		18		2	6		4	
9	18		20		2′	5		2	
380	11	69	12	77	3	6	31	4	23
1	17		16		4	4		6	
2	8		13		5	5		7	
3	11		16		6	6		5	
4	12		11		7	4		7	
5	6	54	5	61	8	5	25	6	31
6	4		9		9	2		2	
7	5		8		440	4		3	
8	8		12		1	7		4	
9	9		7		2	5		6	
390	8	34	10	46	3	0	23	6	21
1	7		8		4	6		2	
2	6		5		5	7		5	
3	5		7		6	3		5	
3′	9		5		7	6		8	
4	6	33	4	29	8	6	22	3	23
5	7		7		9	3		7	
6	3		4		450	3		2	
7	9		8		1	2		5	
8	7		9		2	4		2	
9	5	31	7	35	3	6	18	3	19
400	4		3		4	4		5	
1	7		8		5	7		3	
2	4		6		6	6		4	
3	8		3		7	6		4	
4	4	27	3	23	8	5	29	4	20
5	5		4		9	4		6	
6	6		4		460	5		3	
7	2		4		1	5		9	
8	6		8		2	5		6	
9	3	22	5	25	3	3	24	3	27
410	4		5		4	4		4	
1	3		7		5	6		5	
2	4		5		6	3		2	
3	6		2		7	3		2	
4	3	20	6	25	8	4	21	1	14
5	10		6		9	2		1	
6	7		4		470	1		3	
7	6		5		1	5		2	
8	7		7		2	3		5	
9	5	35	6	28	3	3	14	2	13
420	9		12		4	3		6	
1	10		8		5	2		5	
2	14		6		6	4		3	
3	7		4		7	3		2	

TABLE VIII — NO OF CELLS. — Continued.

No.	Right.		Left.		No.	Right.		Left.	
478	2	14	2	18	533	4	25	5	28
9	0		3		4	4		6	
480	2		5		5	5		3	
1	6		2		6	4		6	
2	5		3		7	5		3	
3	5	18	3	16	8	2	20	4	22
4	6		4		9	4		4	
5	4		4		540	7		5	
6	2		1		1	3		5	
7	4		8		2	6		7	
8	5	21	5	20	3	6	26	6	27
9	5		6		4	3		4	
490	4		5		5	3		2	
1	3		6		6	4		9	
2	1		3		7	3		0	
3	5	18	4	24	8	4	17	5	20
4	6		5		9	6		5	
5	6		4		550	8		9	
6	3		6		1	8		5	
7	5		3		2	4		7	
8	3	23	3	21	3	6	32	5	31
9	5		3		4	7		6	
500	2		7		5	5		6	
1	4		6		6	8		7	
2	5		2		7	6		8	
3	6	22	4	22	8	4	30	4	31
4	5		4		9	5		7	
5	6		3		560	7		4	
6	6		8		1	3		4	
7	7		4		2	5		10	
8	2	26	3	22	3	7	27	8	33
9	5		4		4	5		4	
510	3		5		5	5		6	
1	6		3		6	4		6	
2	3		5		7	5		3	
3	9	26	5	21	8	4	23	5	24
4	8		4		9	6		6	
5	5		6		570	5		4	
6	7		8		1	3		6	
7	6		9		2	5		6	
8	7	34	6	33	3	5	24	3	25
9	5		6		4	2		4	
520	8		5		5	4		3	
1	10		12		6	5		7	
2	8		5		7	5		4	
3	7	38	10	38	8	6	22	3	21
4	9		5		9	4		2	
5	6		5		580	5		3	
6	6		7		1	4		3	
7	8		6		2	3		2	
8	5	34	5	28	3	2	18	4	14
9	5		6		3	3		3	
530	6		4		5	2		2	
1	5		8		6	1		2	
2	5		5		7	3		4	

TABLE VIII.—NO. OF CELLS.—Continued.

No.	Right.		Left.		No.	Right.		Left.	
588	4		3	14	641	11		9	
9	2		5		2	6		5	
590	4		2		3	9	38	7	38
1	1		4		4	8		5	
2	4				5	6		5	
3	5	16	2	16	6	7		8	
4	2		3		7	6		5	
5	4		3		8	7	34	10	33
6	1				9	5		8	
7	2		2		650	6		5	
8	1	10		8	1	7		5	
9	3		4		2	8		7	
600	2		4		3	6	32	5	30
1	7		2		4	10		9	
2	1		3		5	6		7	
3	4	17	3	16	6	6		4	
4	2		4		7	9		6	
5	3		3		8	6	37	8	34
6	5		2		9	5		9	
7	4		5		660	8		7	
8	2	16	3	17	1	10		9	
9	5		5		2	5		8	
610	3		5		3	4	32	7	40
1	5		7		4	6		15	
2	2		3		5	4		5	
3	4	19	6	26	6	3		5	
4	3		4		7	4		3	
5	2		2		8	3	20	5	33
6	3		2		9	5		7	
7	3		2		670	3		2	
8	6	17	8	18	1	2		5	
9	7		8		2	4		4	
620	7		9		3	0	14	6	24
1	8		9		4	4		7	
2	7		8		5	3		2	
3	8	37	9	43	6	5		2	
4	11		9		7	3		6	
5	9		16		8	7	20	6	23
6	6		7		9	3		3	
7	4		9		680	2		5	
8	8	38	6	41	1	4		9	
9	5		7		2	3		2	
630	10		9		3	5	27	3	22
1	5		8		4	6		4	
2	8		9		5	5		4	
3	7	35	6	39	6	3		5	
4	11		8		7	5		6	
5	10		9		8	6	25	6	25
6	9		10		9	7		8	
7	7		6		690	6		6	
8	6	43	8	41	1	4		7	
9	7		10		2	9		6	
640	5		7		3	7	33	8	35

TABLE VIII.— NO. OF CELLS — Continued.

No.	Right.		Left.		No.	Right.		Left.	
694	5		6		749	12		8	
5	5		7		750	6		11	
6	8		8		1	10		10	
7	5		4		2	9		12	
8	9	32	10	35	3	10	47	13	54
9	5		7		4	11		15	
700	8		4		5	6		11	
1	8		9		6	10		11	
2	7		6		7	13		16	
3	6	34	6	32	8	9	49	5	58
4	7		5		9	6		6	
5	4		9		760	15		13	
6	9		8		1	9		11	
7	8		5		2	8		5	
8	6	34	8	35	3	9	47	8	43
9	4		9		4	14		16	
710	5		3		5	13		12	
1	8		3		6	13		11	
2	4		6		7	6		6	
3	7	28	5	26	8	10	56	14	59
4	6		5		9	8		7	
5	4		9		770	9		10	
6	5		3		1	8		8	
7	4		4		2	5		4	
8	3	22	6	27	3	14	44	12	41
9	5		4		4	9		11	
720	13		12		5	5		6	
1	9		6		6	14		11	
2	7		10		7	8		5	
3	11	45	6	38	8	9	45	8	41
4	6		5		9	10		13	
5	10		13		780	11		9	
6	9		11		1	18		18	
7	8		14		2	7		6	
8	10	43	11	54	3	10	56	11	57
9	6		10		4	8		6	
730	6		8		5	9		9	
1	7		8		6	10		9	
2	7		7		7	16		8	
3	1	37	9	42	8	7	50	8	40
4	9		8		9	11		10	
5	9		10		790	9		5	
6	6		7		1	7		8	
7	12		10		2	9		11	
8	5	41	9	44	3	10	46	14	48
9	6		11		4	12		7	
740	9		10		5	6		6	
1	10		4		6	17		11	
2	9		8		7	17		18	
3	8	42	8	41	8	9	61	6	48
4	7		6		9	8		12	
5	6		5		800	5		9	
6	11		9		1	7		11	
7	5		9		2	9		9	
8	8	37	9	38	3	8	37	5	46

TABLE VIII.—NO. OF CELLS.—Continued.

No.	Right.		Left.		No.	Right.		Left.	
804	9		8		845	10		11	
5	9		4		6	11		12	
6	7		6		7	10		10	
7	8		5		8	11	50	7	47
8	9	42	7	30	9	11		12	
9	8		10		850	13		7	
810	11		10		1	13		14	
1	8		7		2	12		14	
2	9		6		3	8	57	10	57
3	13	49	12	45	4	12		8	
4	10		13		5	10		14	
5	9		6		6	18		6	
6	5		7		7	7		8	
7	6		6		8	10	57	8	44
8	9	39	10	42	9	7		11	
9	8		9		860	8		12	
820	7		10		1	6		5	
1	14		10		2	7		6	
2	9		12		3	9	37	4	38
3	16	54	10	51	4	8		7	
4	11		8		5	6		5	
5	9		11		6	8		4	
6	10		13		7	6		5	
7	12		14		8	3	31	3	24
8	14	56	18	64	9	4		6	
9	16		18		870	3		5	
830	10		20		1	3		4	
1	15		8		2	5		6	
2	14		12		3	2	17	2	23
3	16	71	17	75	4	4		3	
4	15		11		5	1		0	
5	10		7		6	3		1	
6	8		10		7	2		2	
7	9		8		8	0	10	1	7
8	17	59	13	49	9	2		0	
9	12		10		880	4		3	
840	13		11		1	2		2	
1	11		14		2	1		0	
2	6		9		3	0	9	0	5
3	8	50	5	49	4	1		1	
4	8		7		5	2		1	

The addition of all the cells gives 5,777 for the right side 5,740 for the left side, as in table I. It will be seen that the numbers in the same section usually differ and often considerably, while each group of five sections or one-tenth mm. shows a closer correspondence.

The total number of the cells varies in proportion to the weight of the frog as shown by

TABLE IX.

Number of frog	49	18	12	36	42	25
Weight in grammes	1½	22	44	63	111	115
Number of cells	4,871	6,760	6,882	8,539	11,517	11,137

In Nos. 12 and 25 only the large cells were counted and tho numbers are therefore too small. Nos. 49, 18 and 43 are male, 12, 14 and 25 female. The ovaries were removed from the latter before weighing. Hence we may conclude that there is a relation between weight and number of ganglion cells not unlike that which obtains between weight and motor nerve fibres.

In the brachial region the cells are distributed in small layers, each only one cell thick, and the spaces between the layers are occupied by the outgoing fibres. In the lumbar region no such arrangement is visible. The motor fibres of the brachial region pass off at right angles to the cord, and in the same way from the motor centre, while those of the lumbar region pass off obliquely both inside and outside of the cord. The most convenient method of showing the distribution of the cells is, therefore, that of taking a unit of space and showing the number of cells in that. I have chosen one-tenth mm. as the space since it is small enough to show the influence of the nerves and large enough to eliminate differences in thickness of the sections. I give the result in tabular form and graphically in plates I and II which are to be compared with the tables.

TABLE X.

Frog No. 49. Weight 1½ grm. No. of cells in each one-tenth mm. See Plate I, Fig. I.

Sum.	Left.	Right.	Sum.	Sum.	Left.	Right.	Sum.
	35	42			25	35	
	37	43			35	32	
	51	51			21	21	
	68	72			26	26	
	89	98			30	32	
	192	137			43	52	
	104	108			52	56	
	90	96			53	53	
	114	131			68	71	
859	129	119	897	431	78	89	467
	120	111			85	75	
	100	89			83	72	
	33	33			87	101	
	26	28			88	97	
	38	22			94	87	
	22	16			95	87	
	26	21			83	80	
	16	19			54	55	
	24	27			29	28	
419	24	25	401	705	7	9	692
				2,414			2,547
						Total.	4,871

TABLE XI.

Frog No. 18. ♂ Weight 22 grm. Plate I, Flg. II.

Sum.	Left.	Right.	Sum.	Sum.	Left.	Right.	Snm.
	43	45			24	27	
	70	70			22	23	
	63	55			23	22	
	56	55			29	19	
	58	60			22	20	
	63	65			24	31	
	79	69			26	25	
	71	83			30	32	
	83	70			39	35	
667	81	82	654	268	29	32	266
	82	78			34	31	
	84	79			34	30	
	69	75			32	41	
	80	83			38	39	
	72	73			48	54	
	78	73			54	57	
	79	83			45	42	
	76	83			49	51	
	74	71			49	49	
751	47	56	754	429	46	39	433
	28	20			52	47	
	23	25			55	50	
	27	32			50	60	
	33	32			66	54	
	24	20			57	61	
	21	20			59	60	
	24	25			56	55	
	19	15			54	65	
	28	33			60	67	
252	25	23	245	576	63	66	585
	24	29			69	62	
	17	17			56	67	
	24	27			45	69	
	21	28			14	22	
	20	28			6	6	
	29	22			6	5	
	26	25					
	27	26					
	21	23					
237	28	20	245	195			201
				3,375			3,383
						Total..	6,758

TABLE XII.

Frog No. 36. Weight 67 grm. Plate I, Fig. III.

Sum.	Left.	Right.	Sum.	Sum.	Left.	Right.	Sum.
	7	11			21	24	
	11	19			18	21	
	32	37			16	13	
	22	35			21	15	
	31	34		214	24	20	197
	40	42			27	26	
	50	45			17	17	
	60	72			25	25	
	59	56			17	21	
358	46	52	403		21	24	
	42	39			20	26	
	40	37			26	27	
	52	54			18	18	
	74	64			10	19	
	62	65		198	17	30	233
	65	69			29	30	
	79	81			22	23	
	81	75			25	29	
	66	62			17	24	
625	64	73	619		26	25	
	62	72			21	33	
	74	74			32	29	
	64	57			17	20	
	62	61			21	21	
	65	69		232	21	21	255
	68	73			16	25	
	77	70			31	30	
	85	87			31	23	
	65	72			31	31	
708	86	69	704		37	37	
	73	71			35	33	
	76	69			45	37	
	78	73			46	45	
	53	50			63	58	
	56	46		396	61	56	375
	27	23			61	67	
	27	29			64	65	
	34	25			55	51	
	21	21			52	46	
465	20	24	440		52	49	
	24	26			55	43	
	27	26			45	45	
	23	20			41	39	
	23	25			34	43	
	35	26		487	28	32	480
	20	23			30	31	
	16	21			29	32	
	14	17			40	37	
	23	24			37	34	
226	21	20	228		40	38	
	23	16			44	41	
	29	23			33	34	
	23	19			36	38	
	22	30			23	25	
	17	17		343	21	13	323

TABLE XII. — Continued.

Sum.	Right.	Left.	Sum.	Sum.	Left.	Right.	Sum.
	6	5			1	1	
	2	3					
	2	4		15			16
	3	0					
	2	1		4267			4272
					Total	8539	

TABLE XIII.

Frog No. 42. Weight. 111 Grm. See Plate II, Fig. IV.

Sum.	Left.	Right.	Sum.	Sum.	Left.	Right.	Sum.
	38	42		607	33	29	618
	19	14			31	35	
	11	13			27	23	
	23	14			22	25	
	20	20			20	25	
	21	20			35	28	
	26	17			34	39	
	26	33			30	27	
	16	23			31	23	
240	40	40	236		25	31	
	42	39		278	23	21	277
	46	48			22	23	
	45	44			18	19	
	50	49			29	20	
	41	39			24	27	
	39	39			21	14	
	49	55			14	13	
	43	49			14	18	
	47	42			18	16	
451	49	61	466		21	20	
	80	58		199	18	24	194
	75	62			22	22	
	68	79			26	22	
	72	70			26	21	
	63	58			34	33	
	60	60			38	38	
	54	54			34	28	
	60	49			25	28	
	67	83			20	22	
650	51	71		274	26	27	262

TABLE XIII.— Continued.

Sum.	Left.	Right.	Sum.	Sum.	Left.	Right.	Sum.
	56	69			17	20	
	56	57			32	31	
	52	75			30	31	
	73	72			27	33	
	63	62			23	24	
	79	65			24	25	
	64	60			22	21	
	65	70			18	14	
	77	67			13	14	
664	79	72	669	222	16	16	229
	65	64			10	8	
	66	68			17	16	
	65	62			16	17	
	73	69			19	26	
	84	67			17	18	
	64	75			37	43	
	69	77			38	31	
	54	61			35	39	
	34	46			43	41	
270	38	38	287		56	59	
	34	33			44	41	
	32	30			45	41	
	37	34			56	57	
	32	40			50	48	
	20	33		477	46	40	479
	14	24			61	48	
	20	23			37	46	
	17	22			42	30	
	25	25			49	45	
264	33	35	299		39	42	
	32	35			54	51	
	34	32			56	64	
	34	35			71	75	
	28	26			59	49	
	22	27		518	50	49	
	45	38			50	47	
	43	54			57	57	
	37	42			57	44	
	41	44			37	38	
358	42	41	374		31	24	
	37	38			17	23	
	47	54			10	7	
	49	58		268	9	5	245
	47	43		5,740			5,777
						Total	11,517

TABLE XIV.

Frog No. 25. ♂ Weight 115 grm. See Plate II, Fig. V.

Sum.	Left.	Right.	Sum.	Sum.	Left.	Right.	Sum.
	23	25			21	21	
	18	20			16	16	
	24	22			23	17	
	32	31			16	14	
	32	35		209	22	23	204
	44	40			20	25	
	50	45			21	18	
	56	49			23	23	
	65	65			25	25	
438	94	76	408		23	28	
	64	64			26	26	
	64	61			29	26	
	58	50			21	25	
	60	51			22	20	
	38	53		229	19	19	235
	39	39			27	24	
	41	62			18	17	
	57	73			27	25	
	56	65			15	18	
547	70	71	589		18	12	
	76	75			16	20	
	90	100			13	19	
	74	72			11	12	
	77	82			18	25	
	79	76		183	20	19	192
	90	91			33	35	
	84	78			37	36	
	77	67			37	34	
	75	66			28	32	
789	67	84	791		37	37	
	77	50			45	36	
	62	58			38	37	
	67	71			41	34	
	65	60			34	30	
	67	59		364	34	34	345
	83	77			36	39	
	62	62			23	32	
	66	73			33	34	
	64	68			32	36	
685	72	70	648		34	32	
	73	69			45	47	
	54	48			38	40	
	39	31			34	38	
	33	26			42	44	
	28	30		360	43	33	375
	18	18			43	35	
	17	19			36	33	
	14	18			34	33	
	21	20			38	36	
314	17	15	294		45	44	
	28	34			44	53	
	25	17			51	47	
	17	21			31	42	
	20	21			57	55	
	21	20		429	50	52	430

TABLE XIV.— Continued.

Sum.	Right.	Left.	Sum.	Sum.	Right.	Left.	Sum.
	44	47			22	20	
	68	70			16	14	
	60	62		383	4	9	417
	58	63			9	10	
	54	55			7	8	
	56	64			3	3	
	54	61			5	3	
	53	45			4	4	
	75	63			3	2	
594	72	68	598		2	2	
	62	70			2	2	
	58	70			1	1	
	54	65		38	2	3	38
	48	52			1	0	
	43	49			1	1	
	44	41		5,564			5,567
	32	27				Total.	11,131

If we consider the tables, or better, the plates, we shall see that the cells are arranged in two great groups, corresponding to the brachial and lumbar enlargements, which are connected by the slender dorsal region. We can then divide the spinal cord into three regions — one for the 1st–3d nerves, the second for the 4th–6th nerves, and the third for the 7th–10th nerves. We will consider each separately:

TABLE XV.

No. of Frog....	49	18	12	36	25	42
Cells of brachial region.....	2076	2828	3204	4061	5306	5104
Total Cells	4871	6758	6892	8539	11131	11517
Per cent. of cells in brachial region.....	44.6	41.6	46.8	47.5	47	45.1

The length of this region does not correspond to the number of cells, as seen by

TABLE XVI.

No. of Frog	49	18	36	25	43
Length of cord, mm	4.1	7.6	11.6	13.9	14.7
Length of brachial region	1.2	2	3.5	4	4.8
Per cent. of total length	29.2	26.3	30.1	31.6	32.7

The cell-bearing part of the cord, only, is measured, and the table shows that the cells lie far closer in the brachial region than in the succeeding ones. It is also plain that there is no correspondence between the outside measurement of diameter of cord, or of the gray matter, and the number of cells contained.

It is further noticeable that the cells are very regularly distributed in the brachial region. There is a sudden rise in number, a tolerably regular maintenance of a maximum, and a rapid diminution at the close of the region. This fact is due to the direction of exit of the fibres, it being, as before said, at right angles to the cord. Part of the third ne ν indeed passes forward and so serves to still more clearly mark the line between the first and second regions. It is not easy to draw a line between the second and third regions. In both the nerves pass off obliquely, and the roots overlap each other in such a way that no sharp rise is seen and no line of division can be drawn.

The two posterior regions together contain, in percentages, the following number of cells.

TABLE XVII.

Number of Frog	49	18	12	36	25	42
	55.3	58.3	53.2	52.5	52.9	54.9

In the second region it is not possible to find, in most cases, enlargements corresponding to the nerves. The cells are pretty evenly distributed.

In the third region several facts are noticeable:

1. The small number of cells in proportion to the weight of muscle supplied. The weight of the leg muscles is far greater than that of the arm muscles, but the ganglion cells, though larger are scarcely more numerous. The fibres of the muscles are much larger in the leg, and of course, investigation should turn on the relation of number of cells to fibres. This has not been worked out.

2. The cells increase gradually to a maximum and very rapidly fall off in number at the rear end.

3 The position of the maximum is variable and probably depends on the relative size of the nerves going into the lumbar plexus. This is well seen in Frog No. 43, where both fibres and cells were counted. An unusually large 10th nerve was found and the maximum of cells is unusually far back. In general the maximum lies near the exit of the 8th nerve.

4. It may be inferred that the nerve fibres do not go far in the cord before uniting with a cell.

5. There is a long string of scattered cells at the posterior end often $\frac{1}{2}$ mm. long.

The exact relation of the maxima of cells to the points of exit of the nerves is not easy to determine on cross sections which alone I have studied. The third nerve passes as already said, forward, and the roots of the posterior nerves overlap. Longitudinal sections prepared by other methods will give conclusions on this point.

A word may be said on the relation of length of cord and number of cells, though no proportional relation was found.

TABLE XVIII.

Frog, No.	49	18	36	25	42
Length of cord, mm	4.1	7.6	11.6	13.9	14.7
No. of cells	4871	6758	8539	11131	11517
Cells per mm	1189	905	636	800	783

It is plain that the length increases more rapidly than the number of the cells. The length is necessarily taken from

the imbedded cord. Proportional results are probably not impaired by this fact, although the exception to the series seen in No. 36 may rest on some irregularity in shrinking during imbedding.

A comparison of cells per mm. in brachial and lumbar regions may be interesting.

TABLE XIX.

Frog, No.	49	36	42
Weight of frog, grammes	1½	67	111
Cells, per mm. brachial	1730	1160	1063
Cells, per mm. lumbar	1352	791	784

The cells lie more closely than in the brachial region, and the number of cells decreases per mm. with the growth of the frog more rapidly in the lumbar than in the brachial region. This fact is plain also in the outer form of the cord which gradually changes from a conical to a cylindrical form. The change is also more rapid in youth than later.

III. Relation of Motor Cells and Fibres.

In frog No. 42, the motor fibres of the right side and the cells were both counted as given in the preceding pages.

The number of motor fibres in the ten nerves on the right side was 5,734.

The number of ganglion cells was, right, 5,777; left, 5,740. The correspondence is so close that we can well conclude that for each motor nerve fibre there is present a ganglion cell in the anterior horn of the cord, and that all ganglion cells therein contained are connected with motor nerve fibres.

Other countings gave the following result:

TABLE XX.

No. of Frog	49	36	42
Motor Fibres of one side	2,992	4,283	5,734
Ganglion Cells of right side	2,457	4272	5,777
Difference	+535	+43	−43

The great difference between the fibres and cells of frog 49, was a surprise to me. It is, however, easily explained. As already said, the nervous elements in a small frog are smaller than in the larger ones. There are thus a larger number proportionately of small cells and fibers. But while osmic acid discriminates easily from the smallest fibres, the corresponding cells are hardly distinguishable from the large embryonic cells found in great numbers in the cord of developing frogs, like the one in question. I therefore suppose that the number given for the fibres is probably the true number for the cells.

I append a figure in which the weight of the frog serves as the axis of abscissas, and the number of ganglion cells and nerve fibres as that of ordinates. It will be seen that there is quite a close correspondence between the lines of cells and and fibres, but that the former shows a too cupid decline in the region of the smaller frogs. The lines should probably run parallel and would do so were the methods for discriminating cells as good as those for fibres.

In Fig. 1 the figures on the lower side of the cut represent the weight of the frogs in grammes; those on the right of the cut, the number of cells or fibres. The broken line represents the curve of the ganglion cells. The upper line shows the nerve fibres, and the lower line the large ganglion cells in those frogs where only those cells were counted. The numbers in the cut refer to those of the frogs examined.

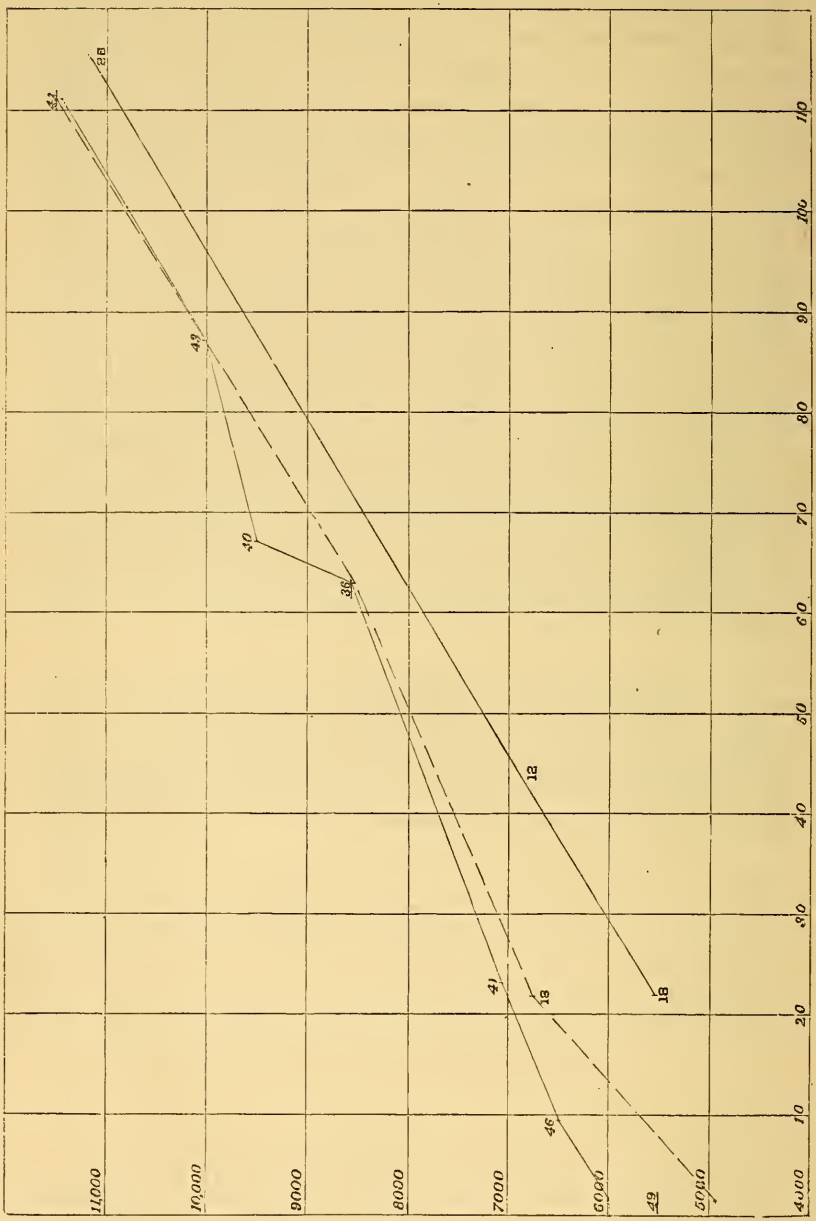

11000
10,000
9000
8000
7000
6000
5000
4,000
110
100
90
80
70
60
50
40
30
20
10
42
28
43
40
38
21
18
41
18
46
49

Fig. 1.

It remains to briefly consider the relation of the fibres and cells of different regions.

TABLE XXI.

Frog No.	36	42
Fibres, Nerves 1–3	4578	6122
Cells of brachial region	4061	5104
Difference	—517	—1018
Fibres, Nerves 4–10.	4088	5346
Cells of dorso-lumbar region	4478	6423
Difference	+390	—1067

The table shows that we have too many cells in the dorso-lumbar region, too few in the brachial. The latter must therefore draw on the former, and, as already remarked, there are ascending fibres from the middle region of the cord.

We can also determine the point where the supply for the lumbar plexus begins.

The first six nerves contain in Frog 36, 5236 fibres, in 42, 7040. In figures II and III this point is marked with *d*, a point in the middle region just above the lumbar enlargement. This confirms previously advanced views.

IV. Number of Sensory Fibres.

The following table gives the facts so far as I have investigated them.

Table XXII.

	No. 41, ♂ Wt. 23 Gr.				No. 36. ♀ Wt. 63 Gr.			
Nerve.	Motor.	Sensory.	Sum.	Trunk.	Motor.	Sensory.	Sum.	Trunk.
I.	652	78	720	718	783	124	907	908
II.	1098	1230	2328	2563	975	1649	2624	3041*
III.	226	143	369	370	481	264	745	749
IV.	119	185	304	301	106	193	299	297
V.	92	188	280	279	114	224	338	339
VI.	137	176	313	314	159	184	343	341
VII.	137	470	608	607	142	562	704	703
VIII.	501	737	1238	1243	870	1101	1971	1955
IX.	450	547	997	1001	441	993	1434	1633*
X.	112	27	139	141	212	41	253	253
Sum.	3524	3781	7295	7325	4283	5335	9618	

It will be seen that except in two cases there is a close agreement between the sum of the roots and the trunks. In those two cases the nerve was so large as to be unstained near its exit from the spinal column, and sections were taken lower down, where the nerve may have been joined by other nerves.

It is plain, (1) that the number of motor fibres is smaller than that of the sensory; and (2), if these two frogs may be taken as examples, that the number varies with the weight of the frog, but not according to the same law as do the motor fibres.

V. Functions of the Motor Ganglion Cells.

Experiments were made with a view of directly determining the function of the group of cells whose numbers were counted. The frog's brain was destroyed and the spinal cord exposed. It was then fastened on a plate like the mechanical stage of a microscope, and its tendo achillis was connected with a registering drum in the usual way. A very fine needle was plunged into the cord by means of a rack-and-pinion movement. It was first inserted into the center of the cord, then withdrawn, the frog was moved one-tenth mm. and the cord again pierced, the needle withdrawn, and the operation was repeated until the whole breadth of cord was passed below the needle. The usual effect of the prick was either nothing or a twitch of the muscle; at one point, however, a tetanus was produced. To determine this point the cord was hardened, imbedded, and a section made at the point experimented upon; a drawing of the section was then divided into as many equal spaces as there had been needle pricks, and it was found that *those pricks which caused a tetanus passed through or close to the group of large ganglion cells.* This was the case whether the cord was pierced from the side or from above. We may then conclude that these ganglion cells have the power of converting into a tetanus, a stimulus which, if applied to the nerve would cause merely a single twitch.

Explanation of Plates.

Plates I and II are a graphic representation of the tables X–XV., and show the number of cells for each one-tenth mm. of length of spinal cord. The vertical line marked O serves as the axis of abscissas and contains as many units of length as does the given cord one-tenth mm. On each side are ordinates erected whose length corresponds to the number of cells at the given horizon. Each space on this axis stands for ten ganglion cells. The figures are placed vertically so as better to show the right and left, anterior and posterior directions of the cord. In Fig. IV. the points of exit of the nerves are marked.

One source of error in the plates should be noted. It is assumed that the sections were cut at right angles to the spinal cord. Since this is never exactly true it happens that a small bilateral asymmetry exists in the figure which may not be found in the cord.

Fig. I. see Table X., page 67.
Fig. II. see Table XI., page 68.
Fig. III. see Table XII., page 69.
Fig. IV. see Table XIII., page 70.
Fig. V. see Table XIV., page 72.

Fig. III.

Number of Cells in $\frac{1}{10}$ m m.

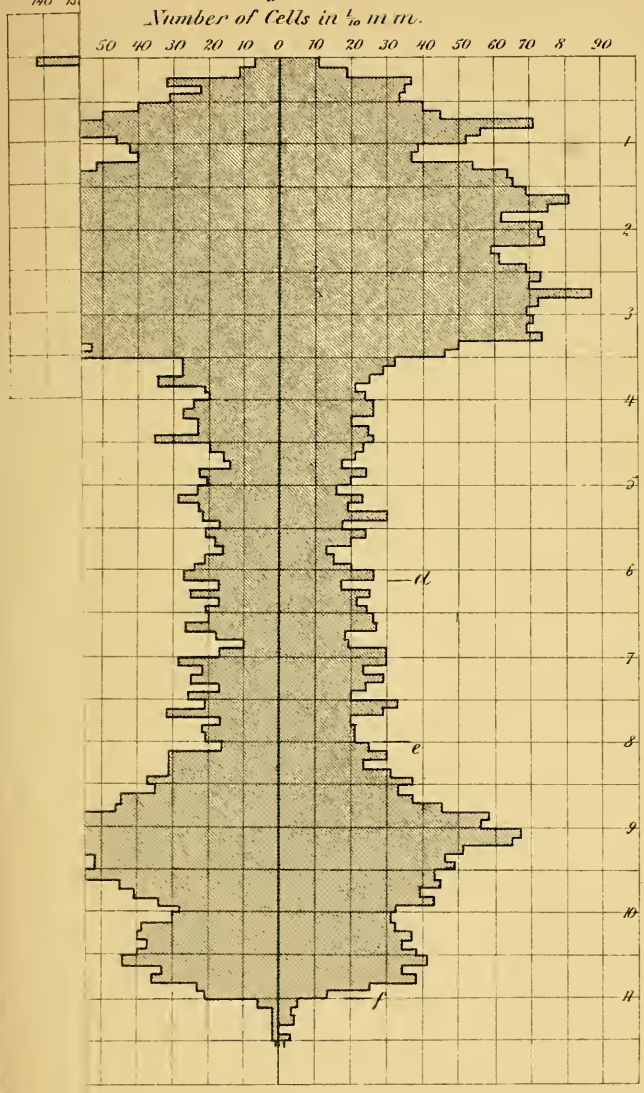


Fig. I

Number of Cells in $\frac{1}{10}$ m m.

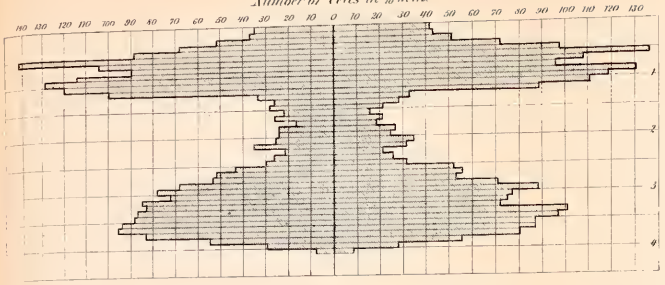


Fig. II

Number of Cells in $\frac{1}{10}$ m m.

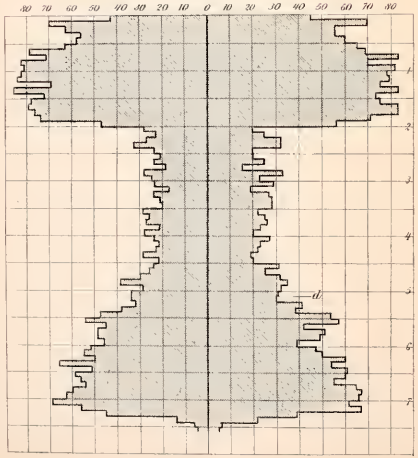


Fig. III.

Number of Cells in $\frac{1}{10}$ m m.

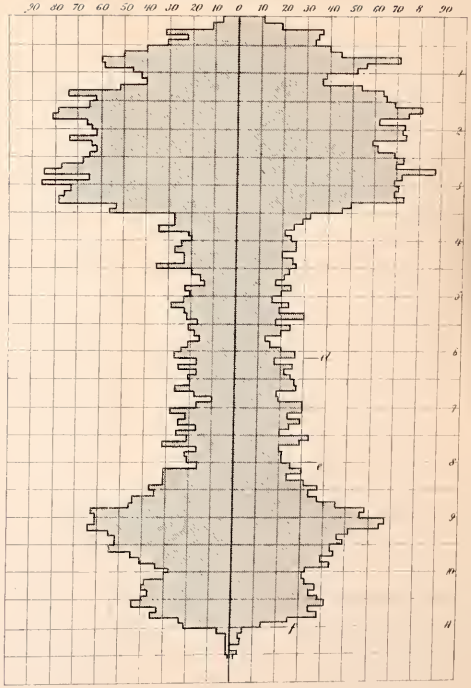


Fig. V

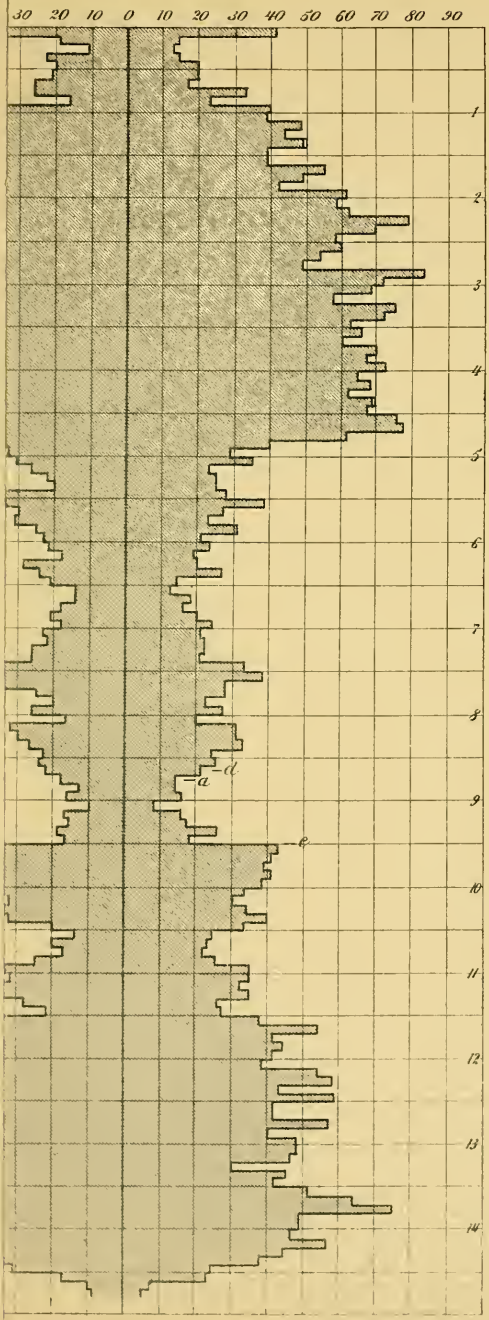

Number of Cells in 1/10 m m.
30 20 10 0 10 20 30 40 50 60 70 80 90
1
2
3
4
5
6
7
8
a
d
9
e
10
11
12
13
14

Fig IV

Number of Cells in 1/10 mm

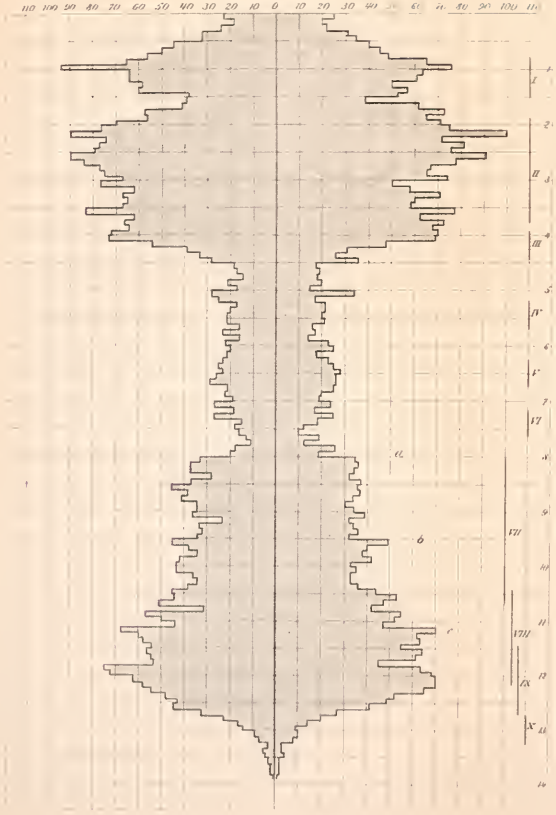
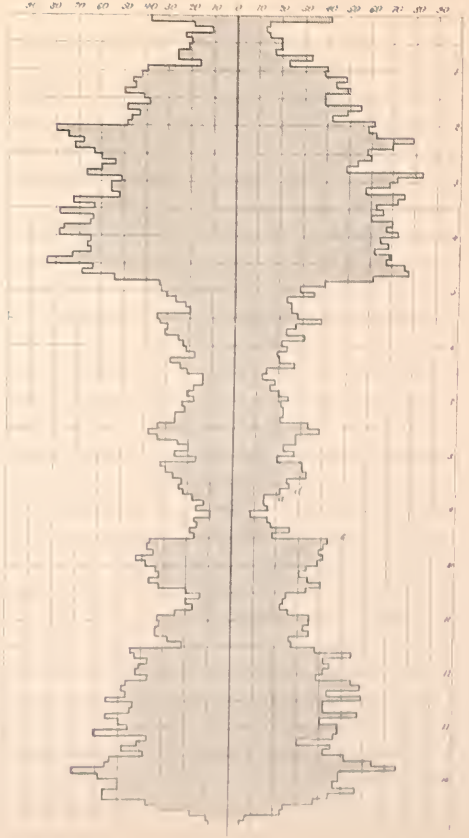


Fig. V

Number of Cells in 1/10 mm



THIRTEENTH ANNUAL MEETING.

DECEMBER 26, 27 AND 28, 1882.

PROGRAMME.

TUESDAY, DEC. 26, 7:30 P. M.

Business Meeting — Reports of Officers.

WEDNESDAY, DEC. 27, 9:30 A. M.

Unfinished Business.

Paper: "Who built the Mounds."— Dr. P. R. HOY, Racine.

Paper: "Who made the Copper tools"— Dr. P. R. HOY, Racine.

Paper: "Greek Religion."— Prof. J. EMERSON, Beloit.

AFTERNOON SESSION, 2:30 P. M.

Paper: "Portraits of Columbus."— J. D. BUTLER, L.L. D., Madison.

Paper: "List of Fungi collected in Wisconsin." — WM. TRELEASE, Madison.

Paper: "Insanity."— A. O. WRIGHT, A. M., Madison.

Paper: "Our knowledge of Stellar Motion."— Prof. T. H. SAFFORD, Williamstown, Mass.

EVENING SESSION, 7:30 P. M.

Paper: (Institute of Christian Philosophy.) "The Unity of Moral Ideas." Rev. C. CAVERNO. Lombard, Ills.

THURSDAY, DEC. 28th, 9:30 A. M.

Paper: "The effect of local attractions on the Plumb line and Sea level." — Prof. J. E. DAVIES, Madison.

Paper: "Nature and Freedom."— Prof. J. J. ELMENDORF, Racine.

Paper: "Sorghum Sugar.' — M. SWENSON, M. S., Madison.

AFTERNOON SESSION, 2:30 P. M.

Paper: (Institute of Christian Philosophy.) "The Ideal Man."— Prof. J. J. ELMENDORF, Racine.

Paper; "The Sochemanni."— PROF. W. F. ALLEN, Madison.

EVENING SESSION, 7:30 P. M.

Unfinished Business.

Paper: (Institute of Christian Philosophy.) "The Universality of Law."— Pres. JOHN BASCOM, Madison.

WHO BUILT THE MOUNDS?

By Dr. P. R. Hoy, Racine.

This question is often asked and variously answered. I purpose to treat the subject with due candor, offering such evidence only, as I consider authentic. Let us have the truth, though it should undermine the fanciful poetic fictions that have, from time to time, been advanced as the true solution of this mooted question. We read in papers and books on this subject, that the great antiquity of works is proven by the trees on or near them that a mound or fortification must be of great age for the trees were from three to four feet in diameter, or the very indefinite expression, there were *large trees* growing in such and such a locality.

Aside from the love of exaggeration, I am persuaded that there is a large margin for error in counting three or four inches of the outer margin of trees and thereupon estimating the age by multiplying the semi-diameter by this partial count.

The giant trees of California have been over and over again declared to be from three to four thousand years of age. In 1875, J. G. Lemmons was sent to ascertain the exact truth and report at the Centennial. On repeatedly counting the rings of at least a dozen trees, he found that their ages were from 1,000 to 1,500 years.

The celebrated tree, the stump of which is used as a floor for a ball room, is just 1.260 years old. Lemmons, during these investigations ascertained that by counting the rings on the outer foot and then, by this, estimating the age, the years would be doubled, for the growths varied from one-third of an inch in the interior, to the thickness of paper on the outside. So after repeated trials, he found that by counting a section one-third of the distance from the inside of the bark toward the centre, the age thus ascertained would correspond with the entire count. This rule was of great value to him in ascertaining the ages of the old prostrate trees. (Botanical Gazette, Vol. 3, Nos. 10 and 11.)

I have measured and counted the rings of many trees and find that in most forest trees Lemmons' rule is equally applicable.

Observation proves that forest trees acquire considerable size in comparatively few years. It is a rule in forestry to cut off the timber in 100 years from the planting, as it is then sufficiently large for all purposes, and after the expiration of one century the waste, decay, etc., equals the increase by growth. The fine shade trees that line our streets in Racine, more especially in the Second ward, are a source of pride and comfort to the citizens. I was one of the earliest settlers in this ward. In 1846–7 an organization for the purpose, planted trees some of which, by this time, have attained somewhat remarkable size. I have recently measured some of the largest. The white elms, *Ulmus Americana*, are from six to eight feet in circumference two feet from the ground. Maples from four to five feet; black and golden willows, eight feet; poplars, *Populus Candicans* eight and a half to nine feet. Not long since I had an opportunity of counting the rings and accurately measuring one of these street elms, finding the diameter two feet from the ground, inside of the bark, twenty-four inches, rings forty-eight,—an average of just one-fourth of an inch to a ring, giving an increase in diameter each year of one-half an inch.

Benjamin Bones, living four miles from Racine, cut down in 1870, a large white elm and on splitting it discovered, four inches from the centre, a blaze which included a hack evidently made by a sharp ax. He brought me a section of the tree including the blaze. There were one hundred and eighty-eight rings outside of the hack, measuring twenty-two and a half inches from inside of the bark to the blaze. Counting back and adding two years for the growths to cover the scar, we found that the period corresponded with Hennepin's first voyage along the west coast of Lake Michigan. A few years before this discovery Dr. Lapham and I amused ourselves tracing Father Hennepin's voyage. We located the spot where he halted and spent several days to recuperate. He says: "At this station the natives and voigeures we had with us killed plenty of stags, wild

goats and many turkeys, big and fat." The point where we located this halt is not over one-half a mile from this famous historic tree, which was fully four feet in diameter. It is probable that 203 years ago some of Hennepin's party blazed an elm sapling as a guide, and now the marks of that hatchet are revealed as sharp and distinct as when first made.

At the time Dr. Lapham and I surveyed the large group of mounds, near Racine, in September, 1850, there was a pin oak sapling growing on the centre of a small mound situated near the house of William Bull. That sapling is now fifty-six inches in diameter although that species of tree is ordinarily not a rapid grower.

Trees that are planted on the mounds, in Mound Cemetery have made a rapid growth being much larger than those planted at the same time in the adjacent grounds.

It has been asserted over and over again, without fear of contradiction, that the "Mound builders were an agricultural people and the Indians not." The truth is that the Indians well deserved the name agricultural.

When white men came to America they found corn in cultivation from latitude forty degrees south, to the St. Lawrence river of the north. Corn must have originated in a warm country, probably in Mexico. How it could have been adapted to the short summers of the regions so far north, is a matter of interesting inquiry. Without other agricultural education than that derived from their own unrecorded and necessarily imperfect observations, the Indians pushed the production of corn from the Gulf of Mexico to the St. Lawrence, Canada, ages before the white man visited them, and it was to the natives that the early settlers were indebted, not only for the seed corn, but for instruction as to planting and cultivation. An annual like corn may extend itself east or west along the same isothermal line by accidental causes, but it could not have moved into a much colder climate without skillful cultivation and careful attention to the selection and improvement of variety. It must have required ages to change it to such a degree as to fit it to grow and ripen in Canada.

When the Pilgrims first came among the Indians they bought great stores of venison and eight hogsheads of corn and beans. (Mourt's Relations. Drake, p. 79.) King Philip, *Metacomet,* was surprised and driven from his home on Mount Hope. The Pilgrims took "what he had worth taking, and spoiled the rest, and also took possession of one thousand acres of corn, which was harvested by the English and disposed of according to their directions." (Old Indian Chronicle. Drake, p. 209.) In the history of the Pequod war it is recorded that the Pequods had "two plantations three miles in sunder, and above 200 acres of corn, which the English destroyed." [Mourt's Relations. Drake, p. 116.) At Philip's Fort, in Rhode Island, there were 500 bushels of corn, stored in sections of hollow trees, each holding about one barrel. These "gums" were so placed as to afford a formidable breastwork. (Dr. I. Mather. Drake, p. 218.)

In the war between the Narragansets and the combined forces of the Mowhegans and Pequots, the latter "committed extensive robberies and destroyed twenty-three fields of corn." This occurred in 1637, so says Roger Williams. (Drake, p. 123.)

In Wisconsin, the Winnebagoes, Menomonies and Pottawatomies raised more corn than they required for their own use Clark says: "Gen Atkinson purchased, he thinks it was 6,000 bushels of corn of the Winnebagoes. In 1848, when my brother and I traveled extensively through Wisconsin, we drove in several instances over old Indian corn-fields, one of which in Columbia county, extended over half a mile. An old pioneer living near by told us the Winnebagoes had cultivaed this large corn-field. The Mandans and Riccarees of the west cultivate corn not only for their own use, but also enough to make it a prominent article of trade." (Antiquites of Wisconsin, page 90.)

Gen. Wayne in his official report of a battle with the Indians of Northwestern Ohio in 1783, says: "A vast destruction of Indian property took place during the expedition. The very extensive and highly cultivated fields and gardens show the work of many hands. The margins of the beautiful rivers appeared like one continuous village for many

miles, nor have I ever before beheld such immense fields of corn. All were laid waste for twenty miles on each side of the rivers." In Western New York there were large fields of corn according to Champlain and Kirtland. In Eastern New York, Hudson mentions there being in several places extensive fields of corn. Marquis De Nouville in his celebrated expedition against the Seneca Indians says: "On the 14th of July, 1685, we marched to one of the large villages of Senecas where we encamped. We remained at the four Seneca villages for ten days. All the time we spent in destroying the corn which, including the old corn that was in *cache,* which we burned, was in such great abundance that the loss was computed at 400,000 minots or 1,200,000 bushels of Indian corn!" This was in Ontario county, New York. (Aboriginal Monuments in the State of New York, pp. 63 and 66.) Newport went up the Powhatan River to visit Powhatan in 1607. He states that Powhatan had extensive fields that came down to the river in which he cultivated corn, beans, peas, pumpkins, tobacco and flax. (Churchill and Holmes, Pickering p. 926.) De Soto speaks frequently of Indian villages that contained from 150 to 600 dwellings constructed of wood; sometimes walled in with stone and protected with tall palisades driven into the ground and surrounded by extensive fields of maize, beans, peas, pumpkins and other vegetables. In one instance he relates that his army passed through continuous fields of maize for two leagues—not a small field of corn even at the present time.

De Soto subsisted his army of one thousand men and two hundred and thirteen horses on the Indians' produce. At one place he took corn enough to feed his entire army for five days. He writes, "on Oct. 18 we came to Mobile, a walled city. which we captured and where we rested forty days. Found great stores of bear's fat, oil of walnuts and honey of bees stored in gourds. On March 3d, departed north with maize enough for sixty leagues."

De Soto's army wandered among and lived on the Indian four and a half years. It certainly took no small amount of corn and other provisions to subsist such an army for so long a period. The Seminoles, Cherokees, Chicasaws, Choc-

taws and Creeks were certainly a well-to-do people in an agricultural sense, at that early day, 350 years since, before the introduction of whiskey, which has well-nigh paralyzed their energies.

It is not uncommon for authors to assert confidently that the mounds were erected by a different race of people from the modern Indians, for the latter have no tradition of the mounds, by whom and for what purpose they were built. Let us consider the subject of *Indian Tradition.* Bartram, the zoologist and botanist, traveled in Georgia, Tennessee, Florida and South Carolina a little over one hundred years ago. He says: "At the Cherokee town of Cowe, on the Tennessee river, which contains one hundred houses, he noticed that the council house, a large rotunda, capable of accommodating several hundred people, stood on the top of an ancient artificial mound of earth, of about twenty feet in perpendicular elevation. The Cherokees themselves could give no account when or by whom the mound was built." At another important Cherokee town, Bartram saw a most remarkable column. It stood adjacent to the town, in the center of an oblique square, and was about forty feet high, and only from two to three feet thick at the base, and tapered gradually to a point at the top. What is remarkable about this pillar is, that notwithstanding it is formed of a single piece of pine timber, the Indians or white traders could give no account for what purpose or at what time it was erected. All the Indians that Bartram asked gave the same answer, which was that the ancient Indians found it there, and that their fathers knew nothing about it. This fact, says Bartram, is not singular, when reference is had to the mound of earth, but when the same answer is given concerning a perishable material, there is at least some slight ground for suspicion.

Another singular circumstance is that no pine trees grew nearer than twelve miles from this point. (Drake's Indians of North America, p. 63.)

None of the Indians at the present time have traditions running back as far as Allouez and Marquette, or even to the more recent time of John Carver. Is it not strange that

they have no knowledge of these men? The Winnebagoes and Menomonees assert positively that they never made flint arrowheads, stone axes or pottery, and that these things must have been made by some one else. White Snake, a chief of the Winnebagoes, said in all sincerity, they were never made by the Indians. (Antiquities of Wisconsin, p. 90, Smithsonian Report of 1879, p. 430.)

In view of these facts what weight has the lack of tradition respecting the mounds? Just none at all.

Jefferson, speaking of the barrows or mounds of Virginia, says: "But on whatsoever occasion they may have been made, they are of considerable notoriety among the Indians. About thirty years ago a party of Indians passing through that part of the country where a mound was situated, went through the woods directly to it, without instruction or inquiry, and staid about it for some time with expressions which were considered those of sorrow. They returned directly to the high road and pursued their journey after spending one half of a day in visiting the mound." (Drake's Indians, p. 56.)

Dr. Samuel Drake studied many of the mounds of Ohio. After describing stone axes, copper implements, flint arrowheads, teeth of carnivorous animals, mica and bone implements, shell beads, and various patterns of pottery, etc., he remarks, "this pottery was made of the same materials employed by the Louisiana Indians within my own recollection, namely, powdered muscle and other river shells, sand and clay."

Dr. Drake, in speaking of the rough stone walls found in several localities in Ohio, said that they were similar to those constructed by the Cherokee Indians of the south. (Drake's Indians, p. 57.)

Atwater, in 1819, surveyed and studied a large number of the ancient works of Ohio. He says: "What the true height of these ruined works was, cannot be very well ascertained, as it is almost impossible to know the rate of their diminution even were the space of time given. But there can be no doubt that most of them are much diminished by the action of the tempests which have swept over them for

ages. That they were the work of a different race from the present Indians, has been pretty confidently asserted; but, as yet, proof is entirely wanting to support such a conclusion. In a few instances European articles have been found in and about some of these works. But few persons of intelligence pronounced these works older than others of the same kind found occupied by the Indians at the time of the French wars." (Drake, p. 60).

Bartram in his travels in Florida relates: "The Indians collected the bones of the tribe and proceeded in a solemn manner to excavate a hole in the ground in which they deposited the bones, and after covering them up they elevated a *circular mound of earth over the spot.*" (Bartram's Travels, p. 514. New York Aboriginal Monuments, p. 68.) When Gen. Oglethrop landed in Georgia, in 1732, he communicated to the Indians the contents of the journal of Sir Walter Raleigh. They pointed out to Oglethrop a place near Yamacran bluff on which there was a large mound in which was buried, they said, a chief who had talked with Sir Walter Raleigh upon that spot. The chief had requested his people to bury him there. (Commissioners' Report on Georgia Affairs, p. 119. Drake's Indians, p. 369.)

A mound opened by Jefferson on the Ravenna river was attributed by him to recent Indians. (Jefferson's Notes on Virginia.)

A document accompanying the President's message of 1806 describes a mound of considerable size erected by the Natchez Indians when they were expelled from Louisiana (President Jefferson's Documents). Forbes was of the opinion that the mounds, thirty miles south of Natchez were erected by the Cherokee Indians. He states that the trees growing on the mounds were decidedly smaller than those growing on the adjacent grounds.

La Salle and his companions visited, two hundred years ago, the Natchez Indians. The town was surrounded by strong earthworks defended by tall stakes. They kept a perpetual fire burning on a mound which was forty-five feet high.

Bartram says in his Antiquities of Southern Indians that in his day the Choctaws erected mounds over the bones of the dead. The chief, *Tomachechi*, pointed out a large mound in which were the bones of a chief who had entertained a great white man with a red beard who came into the Savanna river in ships.

Walker describes many of the Florida mounds in the Smithsonian report of 1879. He excavated systematically a mound at the mouth of the Kootre river. A skull taken from the centre and base of the mound was broken in and inside of the head he found a *rusty iron spike* about three inches in length and a broken arrowhead. Excepting some highly ornamental fragments of pottery, these were all the relics he obtained in this mound. Walker also opened a mound on the south side of Alligator creek. This mound was circular in shape, forty-six feet in diameter, and about three feet in height.

He found many strings of colored glass beads, copper and brass ornaments. Among other curious objects was a pair of scissors and a fragment of a looking glass. By patience and care he obtained many strings of beads in the order they were worn by the owner. In two cases fragments of strings were preserved, seemingly by the copper. Many of the cut glass beads were very beautiful. Walker remarks that this mound could not be older than three hundred and forty years, probably much less. These trinkets may have been derived from De Soto, for tradition points out Phillips point, eight miles north of this mound as the spot where the Spaniards landed. (Smithsonian report 1879, p. 410.)

Dr. S. P. Hildreth opened a mound in Marietta, Ohio, and the circumstances were detailed by the accurate pen of the doctor. He relates: On removing the earth composing an ancient mound in a street of Marietta, the articles found were those belonging to the person over whom the mound was originally made. The articles were silver plated buckles and sword mountings; a streak of rust was all that remained of the blade. The name of Dr. Hildreth is sufficient guarantee that the statements are correct.

This mound must have been erected within a little over three hundred years at most. (Aboriginal Monuments of New York p. 187.)

Several silver crosses, a number of small bags of vermilion and other articles of European origin were discovered by C. A. Vaughn, of Cincinnati, in excavating several mounds in the vicinity of Beardstown, Ill. These articles were found within the skeleton at the base of the mounds. (Ancient Monuments of Mass., p. 146.) A small mound was opened near Chilicothe, Ohio, which was found to contain the skeleton of a girl enveloped in bark. (Ancient Mounds of Mississippi Valley, p. 171.)

In the year 1827, while constructing the Ohio canal a mound was removed under the supervision of William H. Price, at that time a member of board of Public Works. At the base of this mound with the skeleton, was a dial plate and other articles of European origin. (Ancient Mounds of Miss. Valley, p. 146.)

In Benton Township, Cuyahoga County, it became necessary to remove a small mound while excavating the Ohio canal. The remains of one or more human skeletons were found, also a gun barrel and some mountings of the stock. (Ancient Mounds of Miss. Valley, p. 146.)

In Green township, Chenango county, N. Y., there was a mound four feet high situated near Chenango creek, which was opened in 1829.

The mound had a pine stump standing on the top. Great numbers of human bones were found. These skeletons were lying without order, much decayed,and they crumbled on exposure. There were two heaps of flint arrowheads, one of which contained 200 of the usual pattern, color, black and yellow. At another point of the base of the mound, there were more than half as many of a smaller size. In the same mound a silver band or ring two inches in diameter, a number of stone gouges or chisels of different shapes and a piece of mica, heart-shaped and much decayed. (New York Aboriginal Monuments, p. 34.)

A remarkable work situated in Oneida county, N. Y., described by M. B. Clark, was inclosed with two rows of cedar

palisades, they being twelve feet apart and inclosing ten acres. When the ground was first plowed the burnt stumps of these palisades were turned up. In this fort there were six mounds, the largest of which was opened.

Near the base there was a layer of ashes beneath which were human bones, many trinkets made of red pipe stone (catlinite) and a great store of old iron articles consisting of axes, files, knives, etc. (N. Y. Aboriginal Monuments, p. 171.)

Lewis and Clark speaks of a mound in which a great chief of the Omahas had been interred. He was buried upon a hill and a mound six feet in height and twelve feet in diameter was erected over him. (Lewis and Clark Travels West of the Mississippi, New York Monuments, p. 107.)

Beck mentions a large mound on the Osage river which had been erected within the last thirty years by the Osages in honor of a dead chief. (Missouri Gazette, p. 308.)

James, in 1816, upon what he deemed good authority, gives an account of the discovery of a new-made mound which, when opened, disclosed the body of a white officer placed in a sitting position on a mat. (James' Expedition, Vol. 2, p. 38.)

Lapham discovered a mound situated in the town of Oak Creek, Milwaukee County, Wis.

This isolated mound was six feet in height. The sides were much steeper than any he had seen, which indicated that the mound was comparatively recent. Time sufficient to level down or spread out the mound had not elapsed. (Antiquities of Wisconsin, p. 10.)

The mounds near Lake Koshkonong, Jefferson county, Wisconsin, are of a recent construction, as proved by the bones being well preserved and containing considerable animal matter. The numerous bone implements and shell beads, wampun are alike well preserved.

I have studied carefully the large group of mounds situated near Racine, and have excavated fifty of the original one hundred and thirty-eight, which Dr. Lapham and I surveyed in 1850. These Racine mounds being of the oldest type, the bones are entirely destitute of animal matter. I asserted that the specimens exhibited at a meeting of the

Wisconsin Academy of Science, Arts and Letters from Koshkonong were of secondary interment, notwithstanding I was assured they were taken below the center of the mounds, under a stratum of cement, composed of burnt-fresh water shells. In order to prove or disprove Mr. Clark's investigation, a party of scientific men went from Milwaukee and opened one of these Koshkonong mounds. They ran a wide excavation through the center of the mound, starting two feet below the surface of the ground. They were rewarded and fully confirmed Clark's statement, and proved that these mounds are of no great age.

Dr. Sternberger, of the U. S. Army, critically examined certain mounds near Pensacola, Florida. These mounds proved to have been constructed by Indians, as blue glass beads were found in several of them.

Catlin observed a conical mound ten feet in height, erected over the body of a young chief of the Sioux tribe who had been accidentally killed on that spot. (N. A. Indians, vol. 2, p. 107.) James Mathew, a brother of Rev. Father Mathew, of Racine, settled on Zumbro River, in Olmstead county, Minnesota, in 1860. When he first plowed the land there was a mound six feet high and twenty feet in breadth, and so situated that it was in the way of properly cultivating the land, so he made the attempt to plow it down. He sank the plow to the beam repeatedly, but succeeded in reducing the height about two feet. The next year he procured a scraper, and went to work systematically to remove the entire mound. After scraping down the eminence to within about two feet of the base he came to some rotten wood. On carefully removing the top he discovered a kind of cage built of large stakes driven into the ground, as close together as possible, and covered with a split log, finished by plastering the outside thickly with clay, thus forming a rude lodge which was about three feet long and a little less in breadth. In this pen he found one skeleton of an adult in a good state of preservation and with the bones were found two iron hatchets, a dozen flint arrow heads, a copper ring two inches in diameter, a lot of shell beads and a red stone pipe of rather large size and ingeniously ornamented with lead.

Father Mathew visited his brother a few days after this find. On his return he brought the entire lot of implements with him.

George A West, an intelligent and thoroughly reliable gentleman, wrote me an accurate description of a mound opened, and of the interesting relics obtained. His letter is as follows:

RACINE, WISCONSIN, Jan. 15, 1881.

DR. HOY, SR.:

Dear Sir—Knowing that for years, the works of the mound-builders have been closely studied by you, allow me the pleasure of describing to you a few particulars in regard to a mound opened by me in the year 1870.

When an uncle of mine by the name of Davis, was trapping on Root river, in the town of Raymond, Racine Co., he discovered two small mounds on the northwest quarter of section 15. The mounds were situated on the east bank of the river, above highwater mark, yet very near to the stream, on a sand bank. One was partly eaten away by the stream, and the other, situated a few rods away, was covered with hazel bush, with a few large trees standing near by. The mounds were each about ten feet across and two and a half feet above the level of the surrounding ground.

We concluded to open the remaining mound; so after removing the hazel brush and digging about three feet through sand and roots, we came to a bed of hard blue clay, which we threw out in chunks; beneath the clay we came to a sort of a cavity containing fragments of bone and dark streaks of earth, which marked the location of what was at one time a human form.

From the appearance of what remained we concluded that the person must have been buried in a sitting posture; for we found a tooth or two where apparently the pelvis was located, which must have dropped from the jaw above. By exercising care we might have preserved a complete cast of the interred, in the hard clay surrounding him.

Near the center of the mound we found a copper kettle, with a hole in its bottom; within the kettle there was a quantity of dark earth, which was composed mostly of vegetable matter; being such a shapeless mass we were unable to determine just what it might have been. The kettle was about six inches across, with straight sides; it had ears and no bale, and in one place on its side where there had been a hole, there was a rivet inserted, made of copper. The kettle was badly rust-eaten, and when new must have been very thin; Mr. Davis either disposed of it or took it away with him, and where it is remains a mystery. We also found a copper spear head and two irregular pieces of copper. The spear head was about three inches long, with a rivet hole in the shank. The pieces of copper show marks of pounding; they contain particles of silver and quartz, which show that they were never smelted. I am in possession of

them. We, before restoring the mound, dug a foot or two in each direction, but found nothing more.

Very truly yours, GEO. H. WEST.

About fifteen years ago, John Elkins, a jeweler of Racine, told me that he had bought a lot of silver trinkets, ear-rings, belt-slides, and a fine double cross. These, he said, were found in a mound situated in a street in Burlington. Supposing these things to have been a secondary deposit, I made no especial inquiry at the time. However, when I received the report from Mr. West of the Raymond mounds, I determined to investigate the Burlington mounds. With this object in view I attended a meeting of the old settlers association, held in a grove near the village of Burlington, Racine Co., Wis. I called upon F. S. Perkins, who accompanied me to the grove to assist in finding the old Burlington pioneers. We found many who knew that a mound had been removed and that there were lots of silver trinkets and some brass kettles found, but they could give me no further information. They all, however, told me to write to Nathaniel Dickinson, of Elkhorn, Wis., and that I would get a prompt reply, and he would give me all the facts as accurately as if the event was of last week, being a man of extraordinary memory. I wrote to him, and on the third day received a reply as follows :

ELKHORN, WISCONSIN, June 26, 1881.

DR. P. R. HOY:

Dear Sir — There were originally three mounds situated near the junction of the White and Fox rivers. In seasons of freshets the locality of these mounds was covered with water. They occupied an irregular triangle, four to six rods apart.

The mounds in shape were each a section of a sphere. The two smaller ones were three feet in height and fifteen feet in diameter at the base. The remaining one was much larger, being six feet in elevation by twenty in diameter. They were composed of the surface sandy loam and apparently built without extended intermission of time.

In the fall of 1852, I was road commissioner and built a wooden bridge over White river, near where it joins the Fox. This bridge has since given place to one of iron. Requiring some earth for filling the approach I removed one of the small mounds that stood on the street.

When we came to the original surface, we found the shape of four persons, two adults and two children. Each was covered with a thick

stratum of compact clay thus forming a rude kind of sarcophagus. On breaking open these clay cases we found human bones partly decayed and three copper kettles, one of which had some nuts in it, perhaps Pecans; another had what are supposed to be the bones of a rabbit; also, there were many silver ear-rings breast pins and one beautiful double armed, ringed, silver cross, with R. C. in roman capitals engraved in the centre of the upper arm of the cross, also a large quantity of blue glass beads. The remaining small mound we opened out of curiosity. We sank a wide shaft over the centre; when we came to the original surface of the soil and found one clay covered skeleton in a fine state of preservation. There was one copper kettle of rather large size and a small fur-covered, brass-nailed trunk, ten by twelve inches, and eight inches in height. In this trunk we discovered a lot of cheap silver trinkets. In the kettle there was some brown substance which we could not determine and over this brown substance were two or three folds of a woolen blanket.

I might have said, in its proper place that the clay was obtained on the opposite shore of White river, the only locality where this kind of clay could be procured in this vicinity.

A Mr. Stowell built a house over the large mound and when they dug the cellar they removed a part of this mound but nothing was found; still it may be that the centre of the mound was not disturbed. Kettles, silver and crania were scattered, some by gift, others loaned without exacting a return, so that at this time I cannot direct you where you can obtain any of the relics.

Should you require further information in addition to the above commonplace recital you can make any inquiry that you may wish and I will answer. Yours truly,

NATHANIEL DICKINSON.

In answer to further inquiry, I received the following:

The clay-covered skeletons were central, and on a level with the original undisturbed soil, the second mound opened we did not sink below the base of the mound, as it would be of no use, as we fully proved in the case of the one removed, that the soil below was not disturbed, and in the second opened, the water from White river was within two feet of its base, as this mound was at a lower level than the other two mounds.

These two Dickinson mounds, the West mound, on Raymond, and the Mathew mound, in Minnesota, were certainly not older than 300 years, and in all probability not over seventy-five years, judging from the fur-covered trunk and wooden cage.

Mounds are usually found in groups of from three to thirty. In these groups one is almost always much larger

than those placed irregularly about the patriarch of this mound family. In the large mounds it is not uncommon to find secondary burials, which are mostly near the surface. On the other hand, the small mounds are never interfered with, so far as I can ascertain from personal inspection and extensive inquiry. Mounds are not usually opened with sufficient care. In most cases, when the report is that there was a confused heap of bones, critical investigation would prove that the skeletons were originally placed in a sitting position, and that the apparent confusion is caused by the skeletons falling over at various angles, the legs alone retaining their original position.

The Wisconsin mounds are all sepulchral, with the exception of the so-called *animal mounds.*

Squier, after a thorough investigation of the earthworks, mounds and fortifications of New York says:

"In full view of the facts before presented I am driven to the conclusion little anticipated when I started on my trip of exploration, that these earthworks were erected by Iroquois and Senecas or their western neighbors; that the tribes that inhabited New York were to a degree fixed and agricultural in habit." (Aboriginal Monuments of New York, p. 83.)

Further on he says the light thrown upon the Ohio works by those situated in western New York has led to an entire modification of his former views regarding the Ohio works, and to the conviction that they are all of a comparatively late date and probably of common origin.

The flint arrow and spear points, the stone axes, pipes and ornaments, as well as various forms of pottery, are identical in shape, material and workmanship with those known to be used and manufactured by the Indians, when the Europeans first came among them. No one can tell by inspecting these articles whether they were taken from a mound or picked up on the site of a known Indian village. Shell beads found so commonly in mounds and Indian graves were their money — wampum — just such as the Indians living along the New England coast used to make continually. They gathered great quantities of small univalve sea shells

in summer that they could continue the money making during the winter. They managed to bore a hole in these shells with a flint, before the whites furnished them with awls and drills. (Drake's Indians, page 229; Pickering's Chronological History, page 955.)

The various species of large univalve shells, "conchs," so often found in mounds and Indian graves, are yet preserved in the Omaha wigwams as sacred. The sound heard when one of these shells is placed to the ear is supposed to be the voice of departed spirits. (Paper read by Miss Fletcher at Montreal meeting of A. A. A. S.)

Then the mode of burial is still the same, mostly in a sitting posture, surrounded by their worldly wealth and supplied with a sufficiency of food to feed the hungry soul while on the long road to the happy hunting ground. I should like to see that anatomist who can distinguish the crania taken from mounds from those procured from Indian graves. The skulls from mounds differ just as much and just as little as do those of the present tribes of Indians. I obtained a skull of a Pottawatomie chief (it is now in the U. S. A. medical museum at Washington), which is one of the largest known. It is very symmetrical also, the capacity being 1785 cubic centimeters; maximum length, 188.9; maximum breadth, 163.5. circumference, 555.6; facial angle, 75; measured and photographed by order of the surgeon general. I had a second Pottawatomie cranium that is as unlike the above as possible, the capacity being 40 cubic inches less, facial angle 70. In view of the foregoing evidence, the legitimate conclusion must follow that the "mound builders" were Indians and nothing but Indians, the immediate ancestors of the present tribes as well as many other Indians that formerly were scattered over this country. Differing in habits of life and language just as the Indians of the several tribes did before the white man changed them, they continued to build mounds after they had communication with Europeans, since which time mound building, together with many of the arts of the red man, such as making wampum, flint, stone and copper implements, pottery, etc., have declined and finally nearly or quite ceased.

WHO MADE THE ANCIENT COPPER IMPLEMENTS.

By Dr. P. R. Hoy, Racine.

Elsewhere I have considered how the ancient copper implements were fabricated. This paper will be devoted to the answer of the question who made the ancient copper implements, that the plow and spade reveal so abundantly over Wisconsin and sparingly over most of the other states and Canada.

The early explorers upon the St. Lawrence in Canada, on the coast of New England, New York, Virginia, the Carolinas and Florida (among whom we will mention Cartier, Alfonse, Varanzano, Raleigh, Heriot, Ribauld, Newport, Allouez, Champlain and De Soto), all concur in saying that the Indians had implements and ornaments made of copper. Alexander Henry, who penetrated to Lake Superior at the time of the French war, assures us that the Indians obtained copper here which they made into bracelets, beads, spoons and other articles. (Henry's Travels p. 195.)

Dr. Jackson, of Boston, who spent several years on Lake Superior during the early period of the copper excitement, told me (in the summer of 1844, which I spent in the copper region) that "it was undoubtedly the Chippewas that mined, and probably the French half-breeds assisted in these old mines. The fresh condition of the wood work, skids and ladders, and the evidence that sharp axes were used in fitting the timbers is evidence that they are not of great antiquity." Dr. Jackson has published since similar views regarding these old mines.

Charles Whittlesey, U. S. Geologist, in the course of the geological survey of the Lake Superior district, writes: "In the old works on the Minnesota location near the forks of the Ontonogan river there was found at the depth of eighteen feet, a mass of copper weighing eleven thousand five hundred and eighty-eight pounds, which had been taken out of the vein by the ancients. It had been raised a few feet along the slope of the vein by means of wedges and cob-work made of

logs laid up in the form of the body of a small log house. I had a piece of one of these logs which was cut from a black oak tree about six inches in diameter, showing distinctly the marks of a narrow axe, one and three-quarter inches wide, and *very sharp.* The marks of the instrument by which it was cut off were as plain and as perfect as they were on the log and stump recently cut in the vicinity.

Directly over the mass and over the timber which supported it, there stood on the rubbish which covered the mass about twelve feet in depth, a hemlock tree that had two hundred and eighty rings. There was a part of a wooden bowl and a wooden paddle taken from this old mine.

There were a number of wooden paddles found by Doctor Blake, in an old mine, at the Copper Falls mine, all of which were made of white cedar, which is abundant on Lake Superior. Most of these paddles were six feet in length, and resembled those used by the Chippewas in size, shape and material. The handles of these paddles used in the old mines were shaved with a knife or some other sharp cutting tool. In these old mines (Copper Falls), there was a skid with marks showing that it was cut with a sharp ax. There was also a bark spout for conveying the water from the locality. There was a birch tree growing over this debris which was two feet in diameter. The only implements found there which are made of copper, found in the rubbish of the old works, at a depth of from five to fifteen feet below the present surface, were one chisel, five inches long and an inch wide, a gad or wedge and one spear head of the ordinary pattern, four and one-half inches in length, with a socket for a handle." (Annals of Science, edited by Hamilton L. Smith, pages 28–30.)

It was reported by Singaba W'orsa (the head Chippewa chief), that when the Chippewas assembled at their councils from many points of the Lake Superior region, they had abundance of copper which led the council to the conclusion that copper abounded in many locations. In 1826, this intelligent chief piloted the U. S. Indian Commissioner, Gen. McKenny and party, to a celebrated mass of copper which had been long known by the Chippewas.

The commissioners went prepared to remove the mass, with a view of sending it to Washington. "We found it thirty-five miles above the mouth of the Ontanogan river, Lake Superior, on the west bank of the river, a few paces above low water mark. It consisted of pure copper, ramified in every direction through by a mass of stone (mostly serpentine, with calcareous spar), in veins of from one to three inches in diameter, and in some parts exhibiting masses of pure copper of over one hundred pounds. The entire weight of the mass was estimated at from three to five thousand pounds. It was found impossible, owing to the channel of the river being intercepted by ridges of sandstone, forming three cataracts with a descent in all of about seventy feet, to remove this great national curiosity. Evidence was discovered in prying the rock of copper from its position, confirming the history of the past, which recorded the efforts of other parties to extract wealth from this mass. These evidences consisted in chisels, axes and various implements, which are used in mining. This copper mass must have been much larger in dimensions, as no doubt those formerly working it removed much of the copper." (History of Indian Tribes of North America, by Gen. McKinney, Vol. I, p. 159.) This minute account is proof positive that long before 1826 persons operated on this mass of copper with sharp tools.

An extensive find of copper implements near the Sault Ste. Marie has recently been made. It contained twenty-three pieces, consisting of six awls, the largest six inches in length, the smallest three inches, five knives of various sizes and thirteen pieces composed of axes, hammers and chisels. They were found lying piled compactly together, surmounted by a little pile of stones. (*American Antiquarian* Vol. 5, No. 1, p. 89.)

The French penetrated to the Lake Superior region about three hundred and fifty years since — a time quite sufficient to account for all the old mining operations yet discovered.

Newport was told by Powhatan with whom he banqueted April, 1607, that the copper they had "was got in the bites of rocks between cliffs in certain veins a great distance north." (Dr. Pickering's Chronological History, p. 926.)

Granville speaks of copper among the Indians of Virginia which was said to have been obtained of the Shawnees. It was of the color of our copper, but much softer. (Granville's voyages in 1685. Vol. 12, p. 580.)

William N. Rogers, for several years connected with the Indian agency at Keshena, Wisconsin, told me that he frequently saw copper implements in the hands of the Chippeways and Winnebagoes. Many of their pipes were ornamented with copper.

One celebrated calumet which formerly belonged to Black Hawk, now owned by a Winnebago chief, has a broad rim of copper with great blotches of native silver.

The following is a copy of a letter of the Hon. Saterlee Clark, former Indian agent for the Winnebagoes from 1828 to 1830:

HORICON, WIS., May 9th, 1881.

DR. P. R. HOY:

My Dear Sir—In answer to your communication, Feb., 27th, * * *

When I first came among the Winnebagoes many of them had copper-headed weapons.

Many of them carried lances headed with copper, and it was quite common to see arrows headed with copper. Masses of virgin copper both large and small were often found scattered about, but particularly in the sand on the beach of the Wisconsin. This was so pure and soft that it was no trouble to shape it to suit them.

I have never seen any native copper vessels among them of any description, of their own manufacture. Very respectfully,

[Signed.] SAT. CLARK.

The original is in my possession.

I have a perfect copper implement eight inches in length, tapering to a fine point at one end and to a blunt point at the other, form square, each side at the center three-eighths of an inch wide. It was ploughed up with a few Indian bones by William Hass in the town of Caledonia. This grave was situated on a high bank overlooking the Root river. I inspected the grave.

John Trasen, living near the river, told me that there were Indian bones sticking out of the river bank. On visiting the spot we found three graves partially uncovered by the washing away of the bank. Two of the skeletons were

of adults and the third proved to be that of a child. The adult graves were situated ten feet apart and sixteen inches below the surface from above.

On carefully digging we found in each several copper implements, nearly all of which were badly oxidized, while some articles had nearly disappeared. There was a succession of small rounded articles which we took to be copper beads. There were several small cylindrical articles of copper which were three to four inches in length.

In each of these three graves were remnants of pottery. In one of these pots there was a yellow paint that I could not determine. In the second adult grave was a red paint that proved to be vermilion. In connection with the child's grave I found two blue cut glass beads. The balance no doubt were appropriated by the river. In each adult grave there were the leg bones of a deer. The dead were supplied with venison while they lingered on the road to the blessed hunting grounds. A copper lance head was found by George West in Raymond, the description of which is given in West's letter in "On the Mounds."

There were also two pieces of copper, one of which had never been float-copper, but had been mined, as all the deep angles and ridges were sharp and not in the least rounded. The other specimen had been pounded out and a portion cut off had specks of silver associated with the copper.

Prof. Butler exhibited to me a spear head which had been plowed up by Sanford Marsh, in Waukesha county. The hole was filled with what appeared to be iron rust; on scraping he found a small fragment of the rivet. On applying the magnet it proved to be iron.

There can be no doubt that this spear head was manufactured after the Indians traded with the whites. (Since this was written Prof. Butler has published a description of this article in the *American Antiquarian.*)

F. S. Perkins, of Burlington, has collected nearly 400 copper implements, not counting beads, and not one single specimen was taken from a mound. Nearly all were plowed up or picked up from the surface. Mr. Perkins sold his original collection, consisting of 143 copper implements, to the

Wisconsin Historical Society, and has since devoted much energy to the collecting of a second cabinet of copper. He has now about two hundred specimens, many of which are unsurpassed. There are eight axes ranging from two to five pounds in weight. The largest implement weighs ten pounds two ounces. Among this magnificent collection he has ninety spear heads alone.

Near Racine there has been at least one hundred mounds either opened or entirely removed concerning fifty of which I have personal knowledge, and not one single specimen of copper has been discovered in these mounds and as this group is of the oldest type, and as they are situated in the region of abundance of copper, the fact leads to the inference that they were built before copper became of common use among the Indians. This is the more likely as the later mounds have not infrequently articles manufactured from nativecopper. The conclusion follows that the Indians living at no great distance from the copper regions of Lake Superior did mine copper and make various ornaments and implements, not only for their own use, but extensively for the purpose of barter with distant tribes and nations of Indians.

PRELIMINARY LIST OF WISCONSIN PARASITIC FUNGI.

By William Trelease, S. D., Professor of Botany, University of Wisconsin.

The following provisional list of the parasitic fungi of the state includes only species which have been examined by myself. With one or two exceptions, specimens of all have been preserved in my herbarium.[1] Most of the species were collected about Madison, by myself; although I have received much valuable assistance from Mr. L. H. Pammel, a special student in my laboratory, and a most excellent collector,

[1] Dr. Bundy informs me that none of the fungi enumerated in his list in the first volume of the Report on the Geological Survey were saved, so that I have been unable to refer to them.

who has also contributed many interesting forms from La Crosse and elsewhere. A few species have been received from correspondents, whose contributions are acknowledged in each instance.

Professor W. G. Farlow, of Harvard University, has aided me very materially in the determination of doubtful species. My thanks are also due Dr. M. C. Cooke, Prof. C. H. Peck and Mr. J. B. Ellis for similar assistance.

Where names different from those in common use have been employed, in deference to European authority, the synonym most frequently used is added in parenthesis.

As the list now stands it includes about 270 species on approximately the same number of hosts, most of which are phaenogamic plants. This number will probably be nearly doubled by a few years' collecting, especially through the addition of imperfect forms belonging to *Cercospora*, *Septoria*, and related form-genera. To this end, I shall be grateful for specimens from any part of the state, and will gladly render any assistance in my power in their identification.

CHYTRIDINEAE.

1. Synchytrium fulgens Schroeter, var. decipiens Farlow.
   Very common, on *Amphicarpaea monoica* Nutt. Madison, Ithaca; La Crosse, Pammel.

2. Synchytrium anemones (D C.).
   Common, on *Anemone nemorosa* L. Madison.

SAPROLEGNIEAE.

3. Saprolegnia ferax (Gruithus), form Thureti De Bary. (*S. dioica* Auct.).
   On dead flies thrown in water. Madison.

This species has not been found occurring parasitically with us, but it is frequently known to attack living aquatic animals, especially fish, and is the chief cause of the destructive salmon disease of England. It was obtained on some cultures started with cistern water in the spring of 1882, and again, in the fall of 1883, in water taken from a ditch. Antheridia have not been observed. A small percentage of the oogonia show a pseudo-pollinodium projecting into the base of the cell from below.

PERONOSPOREAE.

4. CYSTOPUS CANDIDUS (P.).
   Common, through the open season, on various crucifers,—*Capella bursa pastoris* Moench, *Sisymbrium officinale* Scop., etc. Madison, Syene; Kirkland, La Crosse, Pammel.

5. CYSTOPUS CUBICUS (Strauss).
   On *Ambrosia artemisiaefolia* L., *Cnicus lanceolatus* Hoffm. and *Artemisia biennis* Willd. Madison; La Crosse, Pammel.

6. CYSTOPUS BLITI Biv. (*C. amaranthi*, S.).
   On *Amarantus retroflexus* L. Syene, Madison; La Crosse, Pammel.

7. CYSTOPUS PORTULACAE (D C.).
   On *Portulaca oleracea* L. Madison; La Crosse, Pammel; Sauk City, Lüders.

8. PHYTOPHTHORA INFESTANS (Mont.) (*Peronospora infestans*, Mont.).
   Common, in wet summers, on *Solanum tuberosum* L. Madison; and received from many parts of the state.

In some years the loss from the potato rot is estimated at many thousands of dollars in Wisconsin.

9. PERONOSPORA VITICOLA (B. & C.).
   On various cultivated and wild grapes, and on *Ampelopsis quinquefolia* Michx. Madison, Syene, Ithaca; La Crosse, Devil's Lake, Pammel; also reported from every part of the state.

This certainly causes very much of the dry rot of grapes, as pointed out by Prillieux (Comptes Rendus, Oct. 2, 1882), who has more recently succeeded in observing the germination of the oospores by the direct emission of a mycelial thread, without the intervention of zoospores. I have collected it once producing conidiophores on the fruit.

10. PERONOSPORA HALSTEDII Farlow.
    On *Bidens frondosa* L., *Ambrosia artemisiaefolia* L., *A. trifida* L., *Eupatorium ageratoides* L., *Rudbeckia laciniata* L., *Silphium terebinthinaceum* L., *S. integrifolium* Mx., *S. trifoliatum* L., *S. perfoliatum* L., *Helianthus strumosus* L., *H. occidentalis* Ridd., *H. tuberosus* L. and *Solidago riddellii* Frank. Madison; La Crosse, Pammel.

11. PERONOSPORA OBDUCENS Schr.
    On cotyledons and young leaves of *Impatiens fulva* Nutt. Madison; La Crosse, Pammel. Also found on *Impatiens pallida* Nutt., at Hokah, Minn., by Mr. Pammel.

12. Peronospora geranii Peck.
On *Geranium maculatum* L. Madison, Stoughton; Kirkland, Pammel.

13. Peronospora entospora (Roze & Cornu) (*P. simplex* Peck).
On *Aster novae angliae* L. and several unidentified species of *Solidago.* Syene; Stoughton; La Crosse, Pammel.

14. Peronospora pygmaea Unger.
On leaves of *Anemone nemorosa* L., in May. Madison.

15. Peronospora gangliformis (Berk.).
On *Lactuca sativa* L. and *L. canadensis* L. Madison and Syene; La Crosse, Pammel.

16. Peronospora parasitica (Pers.).
Common, on *Capsella bursa pastoris* Moench, *Lepidium virginicum* L., *Nasturtium armoracia* Fr. and *Brassica* sp. Madison, Syene; Baraboo, La Crosse, Pammel.

17. Peronospora potentillae De Bary.
On *Potentilla norvegica* L. Madison; La Crosse, Pammel.

18. Peronospora arthuri Farlow.
On *Oenothera biennis* L. Stoughton; La Crosse, Pammel.

19. Peronospora viciae (Berk.).
On *Vicia faba* L. and *V. americana* Muhl. La Crosse, Baraboo, Pammel.

20. Peronospora effusa (Grev.).
Common on *Chenopodium album* L., in summer. Madison; La Crosse, Baraboo, Pammel.

21. Peronospora alta Fckl.
On *Plantago major* L. Madison; La Crosse, Pammel.

22. Peronospora calotheca DeBary.
On *Galium boreale* L. and *G. triflorum* Michx. La Crosse, Pammel.

23. Peronospora urticae (Lib.).
On *Urtica gracilis* Ait. Kirkland, La Crosse, Pammel.

24. Peronospora corydalis DeBary.
On leaves of *Dicentra cucullaria* D C. Madison.
Locally abundant, covering the entire lower surface of the leaf with a matted, gray felt.

24*a*. Peronospora leptosperma DeBary.
On *Artemisia* sp. La Crosse, Pammel.

25. Peronospora australis Spegaz. (*P. sicyicola* Trelease, *Botrytis cubensis* B. & C. ?).

Very abundant in summer and fall, on *Sicyos angulatus* L. Madison, Stoughton.

This species was first found in the summer of 1882. Its presence is indicated by pale spots on the upper surface of the leaf, opposite which the fruiting hyphae emerge in dense white tufts 1-3 mm. in diameter, with angular contour, limited by the veinlets of the leaf. Later these spots become dead and white, resembling those caused by *Ramularia, Septoria,* etc.

Berkeley and Curtis describe a *Peronospora cubensis* on a West Indian cucurbitaceous plant (Journ. Linn. Soc., Bot., X., 363), but their description, like many of Berkeley's, is unsatisfactory and does not well apply to our plant. Through the courtesy of Dr. Farlow, I have made a thorough examination of the leaf said to bear *Botrytis cubensis*, in the Curtis herbarium, but whatever it may have once contained has entirely disappeared; and a careful search on the Wright duplicates at Cambridge, which Dr. Farlow was kind enough to make, does not show any *Peronospora.* The species was, therefore, named *P. sicyicola* in my herbarium and in this paper as first presented, and a description was given by Dr. Farlow, in the Botanical Gazette for 1883, p. 331. Since that was published the description of a South American species on *Cyclanthera,* discovered by Spegazzini, has reached this country. So far as can be made out, this is identical with the Wisconsin form, and the name of Spegazzini has the right of priority, dating from 1881. His description is as follows: "Hypophylla; maculae amphigenae, magnitudine ludentes, primo parvulae, dein saepe totum folium occupantes, pallescentes v. fusco-pellucidescentes, angulosae; hyphae mycelii crassae, subtorulosae; haustoria subsphaeroidea v. subclavata, numerosa, saepe totam cellulam plantae hospitalis implectantia; hyphae fertiles hinc inde erumpentes v. e stomatibus exsurgentes, rectae-cylindraceae, longiusculae (250—500×14—15 μ), hinc inde glomerulatae, usque ad verticem continuae, inferne saepe incrassatulae, sed mox breviter ac abrupte coarctato-attenuate, apice subverticillatim 5—12 ramosae; rami 3—6-ies trichotomi, gradatim alternati, ac abbreviati; ramuli ultimi apice incrassatuli, 3—5 sterigmata (3.5×1.5—2 μ) hyalina, subampulliformia, inter se angulo-recto divergentia, saepe 2-3 denticulato-lobata gerentia; conidia obovato-sphaeroidea, sursum obtuse rotundata, saepeque apiculata (15×10—12μ), hyalina."—Ann. de la Sociedad Cientif. Argentina, 1881, XII., p. 81.

In our form the conidial branches are hyaline, tufted from the stomata, often .5 mm. high, with a diameter of 12 μ. 3-4 times branched below. Primary branches alternate, ascending. Ultimate and often penultimate twigs spreading, the lateral ones in pairs, forming crosses with the branch which bears them. Conidia hyaline, subspherical or broadly ellipsoidal, variable in size, averaging 13×16 μ; with an apical papilla, hence probably germinating by zoospores. Oospores not seen.

26. PERONOSPORA LOPHANTHI Farlow.
On *Lophanthus scrophulariaefolius* Benth. La Crosse, Pammel.

27. PERONOSPORA SCHLEIDENIANA DeBary.
On leaves of *Allium cepa* L.
Cal'ed "onion-rust," and very destructive.

28. PERONOSPORA GRAMINICOLA (Sacc.) (*Protomyces graminicola* Sacc., *Peronospora setariae* Pass.).
On leaves of *Setaria viridis* Beauv. and *S. italica* Kunth. La Crosse, and Hokah, Minn., Pammel.
The oospores give some leaves a decided brown color. Conidial branches sparingly produced.

ASCOMYCETES.

GYMNOASCI.

29. EXOASCUS PRUNI Fckl.
On the fruit of *Prunus*, causing "plum pockets" or "bladder plums." Stoughton; Ahnapee, Swaty; Ithaca, Hatch.

30. ASCOMYCES COERULESCENS Mont.
On leaves of *Quercus coccinea* Wang. and *Q. rubra* L. Stoughton; Kirkland, La Crosse, Pammel.

PERISPORIACEAE.

31. UNCINULA ADUNCA (Wall.) (*U. heliciformis* Howe).
Common, in fall, on species of *Salix*, and on *Populus balsamifera* L., var. *candicans* Gray.

32. UNCINULA SUBFUSCA B. & C. (*U. ampelopsidis* Peck).
On *Ampelopsis quinquefolia* Mich. Madison; LaCrosse, Pammel.
This is given the name of Berkeley and Curtis on the authority of Cooke —Journ. Roy. Hort. Soc., 1878, p. 72.

33. UNCINULA AMERICANA Howe (*U. spiralis* B. & C.).
On leaves of cultivated grape, in the fall. Syene.

34. UNCINULA CIRCINATA C. & P.
On leaves of *Acer rubrum* L. Ithaca.

35. MICROSPHAERA EUPHORBIAE B. & C.
On *Euphorbia corollata* L. Madison; La Crosse, Pammel.

36. MICROSPHAERA FRIESII Lév.
On *Syringa vulgaris* L., very common, disfiguring the lilacs in summer and fall. Madison.

37. MICROSPHAERA DIFFUSA C. & P.
On *Desmodium canescens* D C, *Lathyrus ochroleucus* Hook. and *Lespedeza violacea* Pers. Madison; Delton, Devil's Lake. La-Crosse, Pammel.

The form on *Lathyrus* has the 8–12 hyaline appendagas 4–5 times forked, the ultimate divisions unequal, some of them straight, others recurved, closely resembling those of *M. ravenelii* B., which occurs on *Gleditschia*. They are also absolutely indistinguishable from those of *M. pulchra* C. & P., in my collection. Mr. Ellis writes, however, that this form does not differ more from Peck's specimens of *M. diffusa* than the latter do from those of Ravenel distributed by Cooke in Ravenel's Fung. Amer.; in the latter of which they are merely dichotomous and spreading as in my specimens on *Desmodium*, whereas in the former they are only a little less ornate than in my specimen on *Lathyrus*. Professor Peck also regards this as a form of his species.

38. MICROSPHAERA PULCHRA C. & P.
On *Lonicera flava* Sims. and *L. parviflora* Lam. Madison; La-Crosse, Pammel.

39. MICROSPHAERA VAN BRUNTIANA Gerard.
On *Sambucus canadensis* L. Madison.

40. MICROSPHAERA PENICILLATA (Wall.).
On *Corylus americana* Walt. and *C. rostrata* Ait. Very common in the fall. Madison.

41. MICROSPHAERA EXTENSA C. & P.
On leave of *Quercus rubra* L. Madison.

42. MICROSPHAERA RUSSELII Clinton.
On *Oxalis stricta* L. La Crosse, Pammel.

43. PODOSPHAERA TRIDACTYLA (Wall.) (*P. kunzei* Lév., *P. oxyacanthae*, D C.).
Common, on leaves of cultivated cherry and plum, and on *Prunus virginiana* L., causing the leaves to fold lengthwise. Madison, Ithaca; La Crosse, Pammel.

44. PHYLLACTINIA SUFFULTA (Reb.) (*P. guttata*, Wall.).
On *Celastrus scandens* L., *Carpinus americana* Michx., *Corylus americana* Walt. and species of *Cornus* and *Fraxinus*. Madison.

45. SPHAEROTHECA CASTAGNEI Lév.
Common, on *Bidens frondosa* L., *Nabalus* sp., *Taraxacum densleonis* Desf., *Veronica virginica* L., *Rubus triflorus* Rich., *Brunella vulgaris* L. and *Agrimonia eupatoria* L. Madison; La Crosse, Pammel.

46. SPHAEROTHECA PANNOSA (Wall.).

On *Rosa parviflora* Ehr., and on cultivated roses.

The mildew, or mycelium bearing conidia, is very common through the summer and fall, injuring some of the moss-roses very greatly. The perithecial fruit, on the contrary, is uncommon, and seems to form preferably on wild roses, rather late in the fall.

47. ERYSIPHE TORTILIS (Wall.).

On leaves of *Clematis virginiana* L., in summer and fall. Madison; Devil's Lake, Pammel.

No. 558 of Ellis' North American Fungi, on the same host, distributed under the name of *Erysiphe communis* Schl., seems to belong to this species.

48. ERYSIPHE LAMPROCARPA (Wall.).

Very common, on *Ambrosia artemisiaefolia* L., *Helianthus strumosus* L., *Aster miser* L., *A. laevis* L., *Xanthium strumarium* L., *Cnicus discolor* Muhl., *Diplopappus umbellatus* T. & G., *Eupatorium perfoliatum* L., *E. purpureum* L., *Phlox paniculata* L., *P. drummondii* Hook., *Teucrium canadense* L., *Hydrophyllum virginicum* L., *Echinospermum virginicum* Lehm. and *Verbena urticifolia* L.

49. ERYSIPHE COMMUNIS (Wall.).

On *Ranunculus abortivus* L., *Lathyrus venosus* Muhl. and *Amphicarpaea monoica* Nutt. Madison.

Conidia, apparently of this species, are also very common on *Thalictrum dioicum* L.

50. ERYSIPHE GRAMINIS D C.

On *Poa pratensis* L. Madison. Common, through the season, in shaded places.

Only the conidia (*Oidium monilioides* Lk.) have been found, but there can be little doubt that they belong to this species, the perithecial fruit of which forms most frequently on the old leaves.

PYRENOMYCETES.

51. PHYLLACHORA LESPEDEZAE (Schw.) (*Dothidea lespedezae*, Schw.).

On leaves of *Lespedeza capitata* Michx., in summer. La Crosse, and Hokah, Minn., Pammel.

52. PHYLLACHORA PTERIDIS (Reb.) (*Dothidea pteridis* Fr.).

The Pycnidia occur on fronds of *Pteris aquilina* L., from Milwaukee, in the Lapham herbarium.

53. PHYLLACHORA ULMI (Duv.) (*Dothidea ulmi* Fr.).
Very common on leaves of *Ulmus americana* L., in fall and winter, the ascospores forming on the fallen leaves; the spermogonia (*Septoria ulmi* Fr.) on the same host.

54. PHYLLACHORA TRIFOLII (Pers.) (*Dothidea trifolii* Fr.).
With its conidia (*Polythrincium trifolii* Kze.), on *Trifolium repens* L. and *T. pratense* L. Common, in summer and fall. Madison, Ithaca; La Crosse, Pammel; Sauk City, Lüders.

55. PHYLLACHORA GRAMINIS (Pers.) (*Dothidea graminis* Fr.).
Common, on *Asprella hystrix* Willd., *Dactylis glomerata* L., *Elymus canadensis* L., *Panicum latifolium* L. and other grasses, in fall and winter. Madison, Ithaca; La Crosse, Pammel.

56. MONTAGNELLA HELIOPSIDIS (Schw.) (*Dothidea heliopsidis* Schw.).
What appears to be this species was found on the dead stems of species of *Helianthus* and *Aster*, but sterile, as usual.

57. PARODIELLA PERISPORIOIDES (B. & C.) (*Dothidea perisporioides* B. & C.)?
On leaves of *Desmodium acuminatum* D C. La Crosse, Pammel.
What I have referred to this species appears as numerous minute olive-brown or black dots, .5 mm. or less in diameter, on the upper surface of the leaves. These perithecia are smaller than those of any form of *P. perisporioides* in my herbarium, and are pycnidial, containing numerous hyaline round-oblong stylospores, each measuring 3–5μ, and with 1–2 oil globules.

58. HYPOMYCES LACTIFLUORUM (Schw.).
Very common on one or more species of agaric, deforming the infested plants, which are ultimately covered closely by the bright cinnabar-red perithecia.

59. GNOMONIELLA FIMBRIATA (Pers.) (*Sphaeria fimbriata* Pers.).
On leaves of *Carpinus americana* Michx., in August. Pycnidia (*Glaeosporium carpini* Desm.) and ascosporic fruit.

60. GNOMONIELLA CORYLI (Batsch) (*Sphaeria coryli* Batsch).
On leaves of *Corylus americana* Walt. and *C. rostrata* Ait., in summer. La Crosse, Kirkland, and Hokah, Minn., Pammel.

61. PLOWRIGHTIA MORBOSA (Schw.) (*Sphaeria morbosa* Schw.).
Common, on stems of *Prunus virginiana* L., *P. americana* Marshall, *P. pennsylvanica* L. and *P. serotina* Ehrh. Madison; Sauk City, La Crosse, Pammel.
In May, when conidia are abundant on the forming knots, those of the preceding year commonly have the protoplasm of their asci still undiffer-

entiated into spores. A considerable number of specimens show that the species winters very largely by its perennial mycelium rather than by ascospores, and new knots are usually formed close below the old ones by the same mycelium. The "black knot" undoubtedly also occurs on cultivated species of *Prunus*, though I have not yet collected it on them.

62. NECTRIA CINNABARINA (Tode).

On branches of *Robinia pseudacacia* L. Madison.

This with its conidia, *Tubercularia vulgaris* Tode, has been collected only on dead branches; but it has been shown by Dr. Heinrich Mayr (Part 3 of Hartig's Untersuchungen aus dem forstbotan. Institut zu München), that the species sometimes lives as a true parasite on maple, box-elder, etc.

63. CRYPTOSPORELLA ANOMALA (Pk.) (*Diatrype anomala* Peck).

Forming knots on branches of *Corylus americana* Walt. Madison.

64. EPICHLOË TYPHINA (Pers.).

On sheaths of an *Elymus*, *Andropogon furcatus* Muhl. and one other undetermined grass. Madison, Stoughton, Ithaca; La Crosse, Pammel.

65. CLAVICEPS PURPUREA (Fr.)?

Common on *Secale cereale* L., and *Triticum vulgare* Vill. Syene; La Crosse, Pammel.

The sclerotia were not subjected to cultures, and consequently no perithecia were obtained, but there can be little doubt as to the species.

66. CLAVICEPS, sp.

On *Zizania aquatica* L. Milwaukee, Lapham.

The sclerotia are stout, ovoid, oblong, averaging 5×9 mm. Their color is pinkish, brown. I have seen the same thing in the herbarium of Dr. Farlow, but do not know that it has ever been made to fruit.

67. CLAVICEPS, sp.

Small sclerotia have been found in abundance on *Elymus striatus* Willd., *E. canadensis* L., *Koeleria cristata* Pers., *Glyceria nervata* Trin., *Agrostis scabra* Willd., *Deyeuxia canadensis* Beauv., *Poa compressa* L. and *Phleum pratense* L., at Madison, Ithaca, La Crosse and Kilbourn City, by Mr. Pammel and myself. No cultures having been undertaken, however, the species is undetermined.

68. CORDYCEPS MILITARIS (L.) (*Torrubia militaris*, Fr.)?

Conidia on "white grubs" in fall. Madison.

Only the *Isaria* stage was seen, although a number of cultures were undertaken.

69. ———.

On leaves of *Eupatorium ageratoides* L. and *Podophyllum peltatum* L.

Stroma sessile, 3 mm. in diameter, hemispherical, waxy, pale flesh-colored Perithecia superficial. Asci and spores as in *Epichloe typhina* (P.).

A curious fungus, related to *Cordyceps* and *Epichloe*, apparently growing on clusters of spiders' eggs. Possibly connected with *Isaria arachnophila*, No. 76.

PHACIDIACEAE.

70. PHACIDIUM RANUNCULI Desmaz.

On leaves of *Ranunculus pennsylvanicus* L. and *R. sceleratus* L. Madison; La Crosse, Pammel.

Flesh-colored; not dark like English specimens, but otherwise similar to them.

71. PHACIDIUM TRIFOLII (Bernh.).

On leaves of *Trifolium pratense* L. Madison.

72. RHYTISMA SALICINUM Fr.

On leaves of *Salix*. Madison.

73. RHYTISMA ASTERIS Schw.

On leaves of *Solidago*. Sauk City, Lüders. Also found on one or more species of *Aster*, at Brownsville, Minn., by Mr. Pammel.

The compound nature of these galls is discussed in volume IV. of "Psyche."

74. RHYTISMA ILICIS CANADENSIS Schw.?

On leaves of *Ilex verticillata* Gray. Milwaukee, Lapham; Devil's Lake, La Crosse, Pammel.

Forming round or somewhat irregular black spots, about 2 mm. in diameter, surrounded by a brown border, on the upper surface of the leaf—whitish below. The same form occurs on leaves of *I. laevigata* Gray, collected at Ovid, N. Y., by Brewer and Chickering; but all of my specimens are immature.

DISCOMYCETES.

75. PEZIZA DEHNII Rabh.

On petioles and leaves of *Potentilla norvegica* L., in spring and summer. Madison; La Crosse, Pammel.

ISOLATED IMPERFECT FORMS.

76. ISARIA ARACHNOPHILA Ditm.

On spiders, in autumn. Madison. (*Cf.* No. 69).

77. Microstroma leucosporum Mont.

Forming white spots on the under surface of leaves of *Juglans cinerea* L. Represented from just across the line in Minnesota and Illinois, and hence certain to be found in Wisconsin. It should also occur on *Carya*.

78. Didymaria ungeri Cda. (*Ramularia didyma* Ung.).

On *Ranunculus fascicularis* Muhl., *R. recurvatus* Poir. and *Anemone dichotoma* L. Madison: Kirkland, La Crosse, Pammel.

79. Ramularia celastri Ell. & Martin. (*R. celastri* Pk.).

On leaves of *Celastrus scandens* L., in fall. Madison.

Spores 1-4 celled. Described under the same name by Peck (33 Report, p. 30).

80. Ramularia plantaginis Ell. & Martin.

On leaves of *Plantago major* L. Madison, Syene; Kirkland, Pammel.

81. Ramularia tulasnei Sacc. (*R. fragariae* Pk.).

On leaves of *Fragaria vesca* L. and *F. virginiana* Ehr., wild and cultivated. Madison; Milwaukee, Trowbridge; Janesville, Kellogg.

Known pretty generally over the country as "Strawberry Rust."

With us this species appears to pass the winter in black, stromatoid sclerotia, which protrude from the surface of the leaf. In the spring conidial threads grow out from these bodies and quickly fruit.

82. Ramularia arvensis Sacc.

On leaves of *Potentilla norvegica* L. Madison, Syene; La Crosse, Pammel.

83. Ramularia macrospora Fres., var. senecionis Sacc.

On leaves of *Aster novae angliae* L. Syene.

To the naked eye resembling the conidia of *Entyloma compositarum* Farl. Spores colorless, 1–4 celled, usually 2-celled; oblong-ovoid, slightly truncate at the pointed extremities, sometimes narrowed gradually to the septum; 5–6×20–40 μ.

84. Ramularia armoraciae Fckl.

Common on leaves of *Nasturtium armoracia* Fr., wild and cultivated. Madison.

The common leaf disease of the horseradish, very destructive to the old leaves in summer and fall. Presumably occurring on other Cruciferae in Wisconsin, as it does elsewhere.

85. Ramularia urticae Ces.

On *Urtica gracilis* Ait., in spring. Madison.

Agrees closely with Berlin specimens from Magnus.

86. Ovularia obliqua (Cke.) (*Ramularia obovata* Fckl., *Peronospora obliqua* Cke.).
Common, in spring, on leaves of *Rumex*. Madison.

87. Ovularia irregulare (Pk.) (*O. isarioides* Sacc., *Oidium irregulare* Pk.).
On the fruit of *Staphylea trifolia* L. La Crosse, Pammel.

88. Ovularia pyrolae, n. sp.
On leaves of *Pyrola rotundifolia* L. Stoughton.
Spots circular, dark. Spores colorless, round-oval to oblong, frequently acute at one end, unicellular. Usually 4×12 μ; extremes noted: 3.5–6× 6–17 μ.

89. Fusidium ravenelianum Thuem. (*Ramularia desmodii* Cke., *Fusisporium pubescens* B. & C.).
On leaves of a species of *Desmodium* and an *Astragalus*. Madison; La Crosse, Pammel.

90. Fusidium pteridis Kalchbr.
On fronds of *Aspidium marginale* Sw. Kirkland, Pammel.

91. Cercosporella cana (Pass.) (*Fusidium canum* Pass.).
Common, on leaves of *Erigeron canadense* L., in summer and fall. Madison.
What appears to be the same thing was found at La Crosse on the radical leaves of some *Solidago*.

92. Cercosporella apocyni E. & K.
On leaves of *Apocynum cannabinum* L. La Crosse, Pammel.

93. Cercospora apii Fres., var. pastinacae Farlow, *in herb.*
Common, on leaves of *Pastinaca sativa* L. Madison; La Crosse, Pammel.
Perhaps from *Cercosporella pastinacae* Karst., as described in Hedwigia, 1884, p. 63, is not distinct.

94. Cercospora betaecola Sacc.
On *Beta vulgaris* L. Ithaca.
Very destructive to beet leaves, in fall.

95. Cercospora chenopodii Fres.
Very abundant, on leaves of *Chenopodium album* L., in midsummer and later. Madison; La Crosse, Pammel.

96. Cercospora racemosa Ell. and Mart., *ined.*
On *Teucrium canadense* L. La Crosse, Pammel.
Scarcely a good *Cercospora*. I am indebted to Dr. Farlow for the determination.

97. Cercospora physalidis Ell.
On leaves of two species of *Physalis*. La Crosse, Pammel.

98. Cercospora pyri Farlow.
On leaves of *Pyrus arbutifolia* L. Kilbourn City, Pammel.

99. Cercospora granuliformis Ell. & Holway.
On leaves of *Viola cucullata* Ait. Madison; La Crosse, and Hokah, Minn., Pammel.

Polythrincium trifolii Kze.—See Phyllachora trifolii, No. 54.

99*a*. Cladosporium triostei Pk., n. sp.
On leaves of *Triosteum perfoliatum* L. La Crosse, Pammel.
Spots indefinite, pale, becoming brown at the center with age; 2–5 mm. in diameter. Conidiophores tufted, slightly wavy, hypophyllous, 125–150μ long, 3.5μ in diameter, deep brown. Spores dark brown, sometimes slightly paler than the threads; lemon-shaped, with strongly pronounced papillae at either end; 2-celled; 5–7×15–20μ. Septum usually central, sometimes near one end.

100. Passalora depressa (B. & Br.) (*Cladosporium depressum* B. & Br.).
On leaves of *Zizia integerrima* D C. and *Archangelica atropurpurea* Hoffm.? La Crosse, Pammel.

101. Fusicladium dendriticum (Wall.) (*Cladosporium dendriticum* Wall.).
On leaves and fruit of *Pyrus malus* L., *P. coronaria* L. and *P. prunifolia* L. Madison, Ithaca; Baraboo, Johnson; La Crosse, Pammel; and reported all over the state.
The cause of "leaf-blight" and "scab" of apples, and very destructive.

102. Pyricularia grisea (Cke.) (*Trichothecium griseum* Cke.).
On the leaves of *Panicum sanguinale* L. Syene, Madison.
Causing gray spots; common, in the fall.

103. Trichothecium roseum Fr.
On a living puff-ball in August. Madison.
Very possibly growing as a saprophyte on an injured part of the fungus, as it occurs the year round on firewood, old black-knots of cherry, etc.

104. Sepedonium chrysospermum Link.
On a species of *Boletus*. Madison.
Although the host was almost entirely replaced by the conidia, as usual, there was no indication of ascosporic fruit.

105. Asterina, sp. (?).
On leaves of *Salix*, in fall. Syene.
Forming dendritic black spots several millimeters in diameter. Too immature for determination.

106. SPHAERONEMA PERSICAE (Schw.).
On *Plowrightia morbosa* Schw., and on branches of *Prunus americana* Marsh. Madison.
Perhaps growing on the honey-dew of Aphides.

107. GLAEOSPORIUM LINDEMUTHIANUM Sacc. & Magn.
On pods of *Phaseolus*, sp. Madison.
Causing the common and destructive spotting of wax beans.

108. GLAEOSPORIUM (MARSONIA) MELILOTI, n. sp.
On the stems of *Melilotus alba* Lam. Madison.
Perithecia minute, inconspicuous, occurring in longitudinal rows 2–5 mm. long, on the stem. Spores oozing out in pale, flesh-colored tendrils, under the microscope appearing colorless; oblong, straight or slightly curved, 2-celled, 5–6×13–20 μ. In the smaller spores the septum is nearly central; in the larger ones it occurs nearer one end.

109. GLAEOSPORIUM (MARSONIA) JUGLANDIS (Lib.).
On brown spots on leaves of *Juglans nigra* L. and *J. cinerea* L. Madison; La Crosse, and Hokah, Minn., Pammel.
Almost entirely defoliating some trees in August.

109*a*. GLAEOSPORIUM (MARSONIA) CASTAGNEI (Desm. & Mont.).
On leaves of *Populus alba* L. Madison.
Glaeosporium carpini Desmaz.—See Gnomoniella fimbriata, No. 59.

110. PHOMA UVICOLA B. & C.
On cultivated species of *Vitis*. Syene; Ithaca, Hatch.
The apparant cause of much of the "dry rot" of grapes. The form sent by Mr. Hatch is reported as very destructive to the young twigs of some varieties, and appears to be identical with that distributed in Erb. Critt. Ital., No. 747.

111. PHYLLOSTICTA SPHAEROPSOIDEA Ell. & Everh.
On leaves of *Aesculus hippocastanum* L. Madison.

112. PHYLLOSTICTA VITICOLA (Cke.).
On leaves of cultivated grape and *Ampelopsis quinquefolia* Mich. Madison, Ithaca.

113. PHYLLOSTICTA DODECATHEI, n. sp.
On leaves of *Dodecatheon meadia* L. Stoughton.
Spots circular, brown, about 3 mm. in diameter. Spores hyaline, ovoid to oblong, sometimes nearly spherical, eguttulate, 2–5×3.5–7 μ, unicellular.

114. PHYLLOSTICTA QUERCUS Sacc. & Sp.
On leaves of *Quercus macrocarpa* Michx. and *Q. alba* L. Kirkland, La Crosse, Pammel.

115. PHYLLOSTICTA APOCYNI, n. sp.

On leaves of *Apocynum cannabinum* L. La Crosse, Pammel.

Spots circular, brown, about 3 mm. in diameter. Perithecia small, black. Spores colorless, oblong, 3.5–4×5–7 μ, unicellular.

116. PHYLLOSTICTA PYRINA Sacc.

On apple leaves, Madison.

117. PHYLLOSTICTA, sp.

On leaves of *Prunus serotina* Ehrh. Madison.

Spots rounded or oblong, 3–8 mm. in diameter, brownish-red. Perithecia small, black. Spores ellipsoidal, hyaline, 2–4×7–8 μ, unicellular.

Perhaps *P. serotina* Cke., of which I have not been able to examine specimens.

118. ASCOCHYTA, sp.

On leaves of *Silphium integrifolium* Mich. and *Vernonia noveboracensis* Willd. Stoughton; La Crosse, Pammel.

Spots brown, circular, about 3 mm. in diameter. Perithecia brown, 100–120μ, slightly carbonized about the round orifice. Spores colorless; ovoid, oblong or reniform, frequently constricted at the middle; 3–5×7–14μ, with 2–4 oil drops; when mature 2-celled.

Resembles *Phyllosticta sonchi* Sacc. (Michelia, I., 141), except in the septate spores.

119. ASCOCHYTA OXYBAPHI, n. sp.

On leaves of *Oxybaphus nyctagineus* Sweet. Stoughton.

Spots dark brown, roundish, 1–2 mm. Perithecia on the upper surface of the leaf, small, brown, carbonized about the orifice. Spores colorless, 2-celled, 4×10–17μ; sometimes constricted at the middle.

120. ASCOCHYTA VIOLAE Sacc. and Sp.

On leaves of *Viola pubescens* Ait. Madison.

121. ASCOCHYTA QUERCUS Sacc. & Sp.

On leaves of species of *Quercus*; on round, white spots. Madison.

121*a*. ASCOCHYTA AMPELINA Sacc.

On small brown spots, on leaves of *Vitis cordifolia* Mx. Madison.

122. ASCOCHYTA SPARTINAE, n. sp.

On leaves of *Spartina cynosuroides* Willd., in autumn. Madison; La Crosse, Pammel.

This species was found in small quantity, in company with *Uromyces acuminatus* Arthur, and causes small rounded pale yellow spots on the leaves. The spores ooze out in flesh-colored masses, and are colorless, straight or slightly curved, usually a little narrower at one end than the other. They average 3×35 μ. As a rule they are two-celled, but in a few

instances two or even three septa were distinguished. Perhaps identical with some of the numerous described Septoriae or Ascochytae of grasses; but I have been unable to place it.

123. ASCOCHYTA SALICIFOLIAE, n. sp.

On leaves of *Spiraea salicifolia* L. La Crosse, Pammel.

Spots numerous, rounded, about 1 mm. in diameter, deep flesh colored. Perithecia large, similarly colored. Spores oozing out; hyaline, fusiform, usually a little curved in form of a crescent, 1-septate, with several (3–4) oil drops; 2–3.5×30–50 μ.

Referred at first to *Septoria ascochytoides* Sacc., but differs in the absence of a darker border to the spots, while the spores are twice as long as in that species, where they are said to measure 18–20×2.5–3 μ. Perhaps, like the last, more properly a Septoria than an Ascochyta.

124. SEPTORIA RAVENELII THUEM.

On leaves of *Prunus serotina* Ehrh. La Crosse, Pammel.

This occurs in the Curtis herbarium under the name *S. sanguinea* Desm.

125. SEPTORIA NOLI TANGERIS Gerard.

Forming small black spots on cotyledons of *Impatiens fulva* Nutt. Madison.

126. SEPTORIA SISYMBRII Ellis.

On leaves of *Dentaria laciniata* Muhl., in spring. Madison.

127. SEPTORIA ALLIORUM Westd. (*S. viride tingens* Curtis).

On leaves of *Allium tricoccum* Ait., in spring. Madison.

With more distinct spots than the specimens described in Peck's 23d Report, p. 55.

128. SEPTORIA RIBIS Desmaz.

On leaves of *Ribes cynosbati* L. and *R. floridum* L. Madison; La Crosse, Pammel.

129. SEPTORIA VIOLAE West.

On leaves of *Viola pubescens* Ait. Madison.

130. SEPTORIA ERIGERONTIS B. & C., *in herb.* Curtis (*S. erigerontis* Peck).

On radical leaves of some *Erigeron*, in early spring. Madison.

131. SEPTORIA OENOTHERAE West.

On leaves of *Oenothera biennis* L. Madison.

132. SEPTORIA SCROPHULARIAE Peck.

On leaves of *Scrophularia nodosa* L. Madison; La Crosse, Pammel.

133. SEPTORIA HETEROCHROA Desmaz.

On leaves of *Malva rotundifolia* L. Common, Madison.

Also frequently referred to *S. destruens* Desm., by authors.

134. SEPTORIA CANNABINA West.

On leaves of *Cannabis sativa* L., in autumn, Madison. Sometimes accompanied by a *Phoma*.

The diseased hemp leaves were marked by discolored spots very early in the season, but little fruit was formed.

135. SEPTORIA ACERIS (Libert).

On leaves of *Acer dasycarpum* Ehrh. Madison.

A comparison with the original *Ascoxyta aceris* Lib. (Crypt. Ard., No. 54), for which I am indebted to Dr. Farlow, shows very little difference between our plant and the European form. The spores, after their escape, lie loosely over the lower surface of the leaves. In both forms they are straight or more commonly somewhat curved, usually 4-celled, and decidedly constricted at the septa, which, like the external walls, are very thin. The average size is 4×40–$50\ \mu$. Spots very small, yellow.

136. SEPTORIA ASTRAGALI Desmaz.

On leaves of *Vicia americana* Muhl. Stoughton.

137. SEPTORIA, sp.

On leaves of *Aquilegia canadensis* L. La Crosse, Pammel.

Spots blackish, elongated. Spores filiform, $1\times25\ \mu$. Differs from *S. anemones* Desm. chiefly in the spots. Penzig and Saccardo (Atti R. Inst. Veneto, Ser. 6, v. 2.) describe a species under the name *S. aquilegiae*, which produces large black spots on leaves of *Aquilegia atrata*, which is possibly the same, though I have seen only the abstract of their paper in the Bot. Centralblatt, where spore-measurements are not given.

138. SEPTORIA COPTIDIS B & C.

On leaves of *Coptis trifolia* Salisb. Wisconsin, Lapham. *In herb.* Curtis.

139. SEPTORIA PHLOCIS Sacc. & Sp.

On leaves of *Phlox divaricata* L. Madison.

Differs from the typical form in causing larger yellowish or dirty white spots 5 mm. in diameter, which are often confluent. Perithecia numerous. Spores colorless, filiform, 2×30–$40\ \mu$, usually 2-septate.

140. SEPTORIA GRAMINUM Desm.

On leaves of *Setaria viridis* Beauv. and on *Poa annua* L. Ithaca, Syene, Stoughton.

The variety on *Poa* is quite destructive in spring, occurring on the rachis of the panicle and on the floral envelopes, which are uniformly brown. Perithecia round, black, about 80 μ in diameter, prominent. Spores hyaline, slightly clavate, obscurely septate; average size, $2.5\times40\ \mu$.

141. SEPTORIA RUBI (Duby).

On leaves of *Rubus strigosus* Mich. Madison, Syene.

142. Septoria convolvuli Desmaz. (*S. flagellaris* Ell. & Everh.)
On leaves of *Convolvulus sepium* L. Madison.
Spots brown or nearly white, round, 1–3 mm. in diameter. Perithecia small, one or a few on each spot. Spores nearly filiform, colorless, usually 2×40 μ. Not certainly distinguishable from forms of *S. convolvuli*, which varies much on different hosts.

143. Septoria, sp.
On leaves of *Silphium integrifolium* Mich. Stoughton.
Spots angular, blackish-brown, 1-3 mm. in diameter. Perithecia inconspicuous, 60–70 μ. Spores colorless, filiform, about 5-septate, 1.5–2×30–35 μ.

144. Septoria, sp.
On stem of *Ribes*. "Wisconsin, Lapham." *In herb.* Curtis.

145. Septoria polygonorum Desmaz.
On *Polygonum hydropiper* L. Ithaca, Madison; Baraboo, Pammel.
Septoria ulmi Fr.—See Phyllachora ulmi, No. 53.

146. Darluca filum Cast.
On various Uredineae; e. g., *Puccinia polygoni amphibii*, on *Polygonum amphibium*, *P. asteris* on *Aster*, *Uromyces junci*, on *Juncus*, *U. acuminatus*, on *Spartina*, *Puccinia tomipara*, on *Bromus*, *Phragmidium*, on *Potentilla*, *Uredo iridis*, on *Iris versicolor* and *Puccinia menthae*, on *Pycnanthemum*.

BASIDIOMYCETES.

UREDINEAE.

147. Uromyces terebinthi (D C.) (*Pileolaria brevipes* B. & Rav.).
Uredo and teleutospores on *Rhus toxicodendron* L. Madison; La-Crosse, Pammel.
I have not compared this with the European form, but Shroeter has shown that they are identical (Hedwigia, 1875, p. 170).

148. Uromyces polygoni (Pers.).
Uredo and teleutospores on *Polygonum aviculare* L. and *P. erectum* L., in summer and fall; the uredo especially abundant. Madison; La Crosse, Pammel.

149. Uromyces phaseoli (Pers.) (*U. appendiculatus* Lév.).
Uredo and teleutospores on leaves of cultivated beans (*Phaseolus*) and *Amphicarpaea monoica* Nutt. The aecidium on the latter host.

150. UROMYCES OROBI (Pers.).
Aecidium on *Lathyrus venosus* Muhl., *L. palustris* L. and *Desmodium acuminatum* D C. Uredo and teleutospores on *L. venosus* Muhl. Madison; Baraboo, La Crosse, Pammel. The aecidium on *Desmodium*, from Brownsville, Minn.

151. UROMYCES LESPEDEZAE (Schw.) (*U. macrosporus* B. & C.).
Aecidium, uredo and teleutospores on *Lespedeza capitata* Michx Madison; Kilbourn City, La Crosse, Pammel.

152. UROMYCES TRIFOLII (A. & S.) (*U. apiculatus* Strauss).
Aecidium, uredo and teleutospores on *Trifolium repens* L. and *T. incarnatum* L. Madison; La Crosse, Pammel.

152*a*. UROMYCES EUPHORBIAE C. & P.
Aecidium, uredo and teleutospores on *Euphorbia maculata* L. and *E. hypericifolia* L., very common in late summer and fall. Madison; La Crescent, Minn., Pammel.

The aecidium has been distributed by Cooke, on the same host plant, as *A. euphorbiae* Pers. (Ravenel's Fung. Amer., No. 484).

153. UROMYCES ERYTHRONII (D C.) (*U. liliacearum* Ung.).
Aecidium, uredo and teleutospores on *Lilium canadense* L. Madison; La Crosse, Pammel.

The uredo corresponds in every respect with that described by Dr. Farlow in the Proceedings of the American Academy, XVIII., p. 79.

154. UROMYCES JUNCI (Desmaz.).
Uredo and teleutospores on a small *Juncus*. Madison, Syene.

155. UROMYCES HEDYSARI PANICULATI Schw.
Uredo and teleutospores on a species of *Desmodium*. Madison.

156. UROMYCES PYRIFORMIS Cke.
Uredo and teleutospores on *Acorus calamus* L. La Crosse, Pammel.

157. UROMYCES CALADII (Schw.).
Aecidium, uredo and teleutospores on leaves of *Arisaema triphyllum* Torr. Madison; Kirkland. Pammel.

Peck has given the synonymy of this species in full in the 29th Report on the New York Cabinet of Natural History, p. 67.

158. UROMYCES HYPERICI (Schw.).
Aecidium on *Elodes virginica* Nutt. Teleutospores on *Hypericum pyramidatum* Ait. La Crosse, Pammel.

159. UROMYCES SOLIDAGINIS Niessl.
Teleutospores on *Rudbeckia laciniata* L. La Crosse, Pammel.

160. UROMYCES ACUMINATUS Arthur.
Uredo and teleutospores on *Spartina cynosuroides* Willd. Madison; La Crosse, Pammel.

A very variable species, which in some of its forms can scarcely be distinguished from a species on several grasses from other parts of the country, which may be a form of the variable *U. dactylidis* Otth.

161. PUCCINIA CIRCAEAE Pers.
Teleutospores very abundant on leaves of *Circaea lutetiana* L. Madison; La Crosse, Pammel; also collected at Hokah, Minn., by Mr. Pammel.

162. PUCCINIA ANEMONES VIRGINIANAE Schw. (*P. solida* Schw.).
Teleutospores on *Anemone virginiana* L. and *A. cylindrica* Gray, in August. Madison; La Crosse, and Hokah, Minn., Pammel.

163. PUCCINIA THALICTRI Chevall.
Teleutospores on *Thalictrum dioicum* L. and *T. cornuti* L. Madison; Kirkland, La Crosse, Pammel.

I do not see how this can be distinguished morphologically from *P. anemones* Pers. It is usually marked with larger and more obtuse warts than our specimens of the latter, but European specimens of *P. anemones* sometimes have quite as coarse granulations as our *P. thalictri.*

164. PUCCINIA HYDROPHYLLI Peck & Clinton.
Teleutospores on *Hydrophyllum virginicum* L. Madison.

165. PUCCINIA LOBELIAE Ger. (*P. microsperma* B. & C.).
Teleutospores on *Lobelia syphilitica* L., in August. Madison.

166. PUCCINIA VERRUCOSA (Schultz). (*P. hyssopi* Schw.).
Teleutospores on *Lophanthus scrophulariaefolius* Benth. La Crosse, Pammel.

167. PUCCINIA SILPHII Schw.
Teleutospores on *Silphium perfoliatum* L. and *S. integrifolium* Mich. Stoughton; La Crosse, Pammel.

On the latter host sometimes accompanied by the spermogonia of an aecidium, in June. (*cf.* No. 242.)

168. PUCCINIA ASTERIS Duby. (*P. asteris* Schw.).
Teleutospores on *Aster corymbosus* Ait., *A. cordifolius* L. and *A. tradescanti* L. La Crosse, Dells of the Wisconsin, Pammel.

169. PUCCINIA SOLIDAGINIS Pk.
On leaves of *Solidago nemoralis* Ait. (?) La Crosse, Pammel.

Paler than the type, which it otherwise resembles, according to Professor Peck.

The teleutospores are often forked; in some cases the division extends merely through the terminal papilla; in others the lower cell is produced into a thickened papilla just below the septum.

170. PUCCINIA TOMIPARA, n. sp.

Uredo and teleutospores on a species of *Bromus*, apparently *B. ciliatus* L. La Crosse, Pammel.

II. Sori small, round, or little elongated, on the upper surface of the leaf. Spores commonly round, somewhat roughened with blunt, inconspicuous warts; pale yellow, 22–26 μ.

III. Sori compact, black, long covered by the epidermis; round or slightly elongated, usually about .2 mm. in diameter. Spores pale chestnut-brown, thin walled, without apical thickening; irregularly oblong, sessile; 2–5-celled, often tomiparous; 13–22×35–43 μ.

The species is remarkable from the fact that the spores are commonly 3–4-celled, with the uppermost septum oblique or not infrequently parallel to the axis of the spore, which is thus made to consist of more than one row of cells. It somewhat resembles *P. triarticulata* B. & C., which occurs on *Elymus*, and which has 3-celled spores; but these are longer and differently shaped.

171. PUCCINIA BARYI (B. & Br.) (*P. striatula* Thuem., *P. linearis* Pk.).

Uredo and teleutospores on some dead grass, possibly *Andropogon scoparius* Michx. Madison.

Well marked by the strongly clubbed paraphyses.

172. PUCCINIA ANDROPOGI Schw. (*P. ellisiana* Thuem.).

Teleutospores on *Andropogon scoparius* Mx. Madison; Milwaukee, Lapham; La Crosse, Pammel.

This has been compared with Schweinitzian specimens, by Dr. Farlow. The teleutospores are not unlike those of *P. cesati* Schr., as described by Winter.

173. PUCCINIA ARUNDINARIAE Schw.

Teleutospores on dead leaves of *Spartina cynosuroides* Willd., in winter and spring. Madison.

174. PUCCINIA EMACULATA Schw. (*P. graminis* P., var. *brevicarpa* Peck).

Teleutospores on *Panicum capillare* L. Madison; La Crosse, Pammel.

175. PUCCINIA VEXANS Farlow.

The form described by Peck as *Uromyces brandegeei*, but now held to be the uredo or mesosporic form of this species, was found once on *Bouteloua racemosa* Lag., at La Crosse, by Mr. Pammel. The quantity examined was small, and no teleutospores were seen.

176. PUCCINIA PHRAGMITIS (Schum.) (*P. arundinacea* Hedw.).
Uredo and teleutospores on *Phragmites communis* Trin. Milwaukee, Lapham; La Crosse, Pammel. Also collected at Hokah, Minn., by Mr. Pammel.

177. PUCCINIA MAYDIS Carrad. (*P. sorghi* Schw.).
Uredo and teleutospores on the leaves of *Zea mays* L., common, in summer and fall. Madison.

Cooke has described an Asiatic species on Indian Corn, under the name of *P. purpurea*, the teleutospores of which do not appear distinct from ours. The purplish discoloration of the leaves which it induces, and from which it derives its specific name, is not characteristic, for some of the Wisconsin specimens of *P. maydis* occur on decidedly purplish spots, and Dr. Farlow informs me that Italian specimens of the same species are often purple. An examination of Indian specimens of *P. purpurea*, for which I am indebted to Dr. Farlow, shows, however, that the uredo spores are rather larger and more oblong than those of our plant; and they are accompanied by nearly colorless, thick-walled, clavate paraphyses, which are wanting in our species.

178. PUCCINIA POLYGONI AMPHIBII Pers. (*P. polygonorum* Lk., *P. amphibii* Fckl.).
Uredo and teleutospores on *Polygonum amphibium* L. Madison; La Crosse, Pammel. Also collected at Brownsville, Minn., by Mr. Pammel.

The parasite is very commonly attacked and greatly deformed by *Darluca filum* Cast.

179. PUCCINIA PRUNI SPINOSI (P.) (*P. prunorum* Link).
Uredo and teleutospores on leaves of seedling *Prunus americana* Marsh. and on those of older plants of the same species and of *P. virginiana* L., in late summer and fall. Madison.

180. PUCCINIA ARGENTATA (Schultz) (*P. noli tangeris* Cda.).
Uredo and teleutospores on *Impatiens fulva* Nutt., in fall. Madison.

As no aecidium accompanies this species in Europe, our *Aecidium impatientatum* Schw. must be considered as probably belonging to some heteroecismal species, although it occasionally occurs on the same leaves with the *Puccinia*.

P. argentata has also been found on *Impatiens pallida* Nutt., at Hokah, Minnesota, by Mr. Pammel.

181. PUCCINIA AMORPHAE Curtis.
Uredo and teleutospores on leaves of *Amorpha canescens* Nutt. and *A. fruticosa* L., common. Madison; La Crosse, Pammel. Also collected at Hokah, Minn., by Mr. Pammel.

182. PUCCINIA PETALOSTEMONIS Farlow, *in litt.*

Uredo and teleutospores on *Petalostemon.* La Crosse, Pammel.

II. Sori round, brown, surrounded by the ruptured epidermis, which is elevated so as to form a false-peridium. Spores pale brown, ovoid, nearly smooth or somewhat granular on the surface. Average size, 20×22 μ.

III. Sori similar to those containing uredo spores, black. Spores medium brown, broadly ellipsoidal, slightly constricted, thin-walled, without apical thickening, surrounded by a smooth gelatinous sheath; average 20×33 μ.

The species is related to *P. amorphae* Curt., but readily distinguished by the paler and more transparent teleutospores, and the thinner, smooth envelope. Pale-amber paraphyses, frequently hooked at the tip, accompany both uredo and teleutospores.

183. PUCCINIA ZYGADENI, n. sp.

Teleutospores on *Zygadenus glaucus* Nutt. La Crosse, Pammel.

Sori small, rounded; on both sides of the leaf. Spores amber-brown, darker at the apex, on thin walled colorless pedicels; oblong or sometimes clavate; but slightly constricted. Apex thickened, usually rounded or truncate, rarely acute. 16–20×33–56 μ; commonly about 17×43 μ.

This resembles a specimen in the Curtis herbarium, on *Amianthium*, which is labeled *P. asphodeli* Duby. "It corresponds closely to a specimen from France, bearing the same name, but evidently incorrectly named, as other specimens from France and Italy, with the same name, are quite different." (Farlow, *in litt*).

184. PUCCINIA ALETRIDIS B. & C.

Uredo and teleutospores on *Aletris farinosa* L. Kilbourn City, Pammel.

The uredo sori are small; their spores pale yellow, round-ellipoidal, thin walled and sparsely granulated. Their usual size is about 20 μ.

185. PUCCINIA KUHNIAE Schw.

Teleutospores on *Kuhnia eupatorioides* L., in the fall. Madison; La Crosse, Pammel.

186. PUCCINIA PODOPHYLLI Schw. (*P. aculeata* Schw.).

Teleutospores common on *Podophyllum peltatum* L., in June. Madison, Kilbourn City; La Crosse, Pammel.

Sometimes accompanying or preceded by *Aecidium podophylli* Schw., but frequently found where there is no trace of the latter.

187. PUCCINIA XANTHII Schw.

Teleutospores on *Xanthium strumarium* L. and *Ambrosia trifida* L. Madison; La Crosse, Pammel. Also collected ot Hokah, Minn., by Mr. Pammel.

In New England, this is often preceded by an aecidium, according to Dr. Farlow.

188. PUCCINIA FUSCA (Relhan) (*P. anemones* P.).
Teleutospores very abundant, in spring, on *Anemone nemorosa* L. Madison.

The aecidium occurring simultaneously on the same species is *A. punctatum* Pers., and not *A. leucospermum* D C., which is said by European authorities to be a stage of this species. It is frequently associated with *Peronospora pygmaea* Ung. and *Urocystis anemones* (Pers.), but I have never seen it on the same leaf with the brown aecidium.

189. PUCCINIA CONVOLVULI (P.).
Aecidium (*A. dubium* Clinton, *A. calystegiae* Cast., *A. convolvuli* Ces.), uredo and teleutospores on *Convolvulus sepium* L. La-Crosse, Pammel.

190. PUCCINIA GALII (Pers.).
Spermogonia on *Galium aparine* L., in May. Uredo and teleutospores on *G. triflorum* Michx., in summer and fall. Madison; La-Crosse, Pammel.

The teleutospores are uniformly more thickened at the apex, and more clavate in general outline than those of *P. valantiae* Pers., to which the American form has sometimes been referred. The presence of uredospores is also characteristic, and the occurrence of spermogonia indicates that the aecidium will ultimately be found, although I am not aware that it has yet been recorded in this country.

191. PUCCINIA PIMPINELLAE (Strauss) (*P. myrrhis* Schw.).
Aecidium, uredo and teleutospores on *Osmorrhiza brevistylis* D C. Madison; Kirkland, Pammel.

192. PUCCINIA MENTHAE Pers.
Aecidium on *Monarda fistulosa* L. and *Lycopus europaeus* L. Uredo and teleutospores on *Mentha canadensis* L., *Pycnanthemum lanceolatum* Pursh, *Monarda fistulosa* L. and *M. punctata* L. Madison; Sauk City, Lüders; La Crosse, and Hokah, Minn., Pammel.

193. PUCCINIA GENTIANAE (Strauss).
Uredo and teleutospores on *Gentiana andrewsii* Griseb., in autumn. Madison.

194. PUCCINIA FLOSCULOSORUM (A. & S.) (*P. compositarum* Schl., *P. variabilis* Grev., *P. hieracii* Mart.).
Uredo and teleutospores on *Taraxacum dens-leonis* Desf., *Hieracium canadense* Mx., *H. scabrum* Mx., *Cnicus altissimus* Willd., *C. lanceolatus* Hoffm. and *C. discolor* Muhl. Madison; Devil's Lake, Pammel.

Probably several of the aecidia referred to *Aecidium compositarum* Winter belong to this species.

195. PUCCINIA HELIOPSIDIS Schw.

Uredo and teleutospores on *Vernonia fasciculata* Michx. La Crosse, Pammel.

Scarcely distinct.

196. PUCCINIA TANACETI D C.

Uredo and teleutospores on *Artemisia dracunculoides* Pursh. Madison.

197. PUCCINIA HELIANTHI Schw.

Aecidium (*A. helianthi* Schw.) on *Helianthus strumosus* L. Uredo and teleutospores common on *H. grosse-serratus* Mart., *H. annuus* L. and *H. strumosus* L. Madison, Syene; La Crosse, Pammel.

The broader uredospores and the paler apex of the teleutospores distinguish this from the forms of *P. tanaceti*, with which Winter unites it, that I have been able to examine.

198. PUCCINIA VIOLAE (Schum).

Aecidium on *Viola cucullata* Ait., *V. pubescens* Ait. and *V. canadensis* L. Uredo and teleutospores on *V. cucullata* Ait., *V. blanda* Willd. and *V. pubescens* Ait. Madison, Stoughton; Delton, Devil's Lake, Kirkland, Pammel.

199. PUCCINIA RUBIGO VERA (D C.) (*P. straminis* Fckl.).

Uredo and teleutospores common, on *Hordeum jubatum* L.

Aecidium asperifolii Pers., which is said to belong to this species, and which occurs on various Borragineae, has not been found yet.

200. PUCCINIA GRAMINIS Pers.

Aecidium (*Aecidium berberidis* Gmel.) very common in spring, on *Berberis vulgaris* L., wherever the barberry is cultivated. Uredo and teleutospores abounding on many grasses, of which the following have been collected: *Triticum vulgare* Vill., *Avena sativa* L., *Phleum pratense* L., *Hordeum jubatum* L., *Agrostis vulgaris* With., *A. scabra* Willd., *Briza maxima* L., and *Elymus*, sp. Ithaca, Madison, and reported from many other localities.

The uredo appears sparingly in the spring, before aecidia have developed on the barberry, and there is reason for believing that the mycelium hibernates in winter grain and perennial grasses. Although the barberry does not grow wild in the state, it is cultivated in sufficient abundance to stock the state with wheat rust in favorable seasons. The teleutospores are found in fall and winter, and are especially noticeable on the sheaths of grasses, after their death. Attempts made in my laboratory to infect the very young leaves of wheat seedlings with the sporidia from germinating teleutospores have thus far entirely failed, though Plowright claims to

have succeeded. If this were possible it would entirely do away with the necessity for the intervention of the barberry, which, as has been said, is questionable, for other reasons.

201. PUCCINIA CORONATA Cda.

Uredo and teleutospores very common, on *Dactylis glomerata* L., *Avena sativa* L., etc. Madison. The common oat rust in this vicinity is the uredo of this species.

Aecidium rhamni Gmel., which is held to be a state of this species, has not yet been found. It should be looked for on species of *Rhamnus*.

202. PUCCINIA CARICIS (Schum.).

Aecidium (*Aecidium urticae* Schum.) common, in spring, on *Urtica gracilis* Ait. Uredo and teleutospores on *Cyperus schweinitzii* Torr., and other sedges, in fall and winter, common. Madison; La Crosse, Honey Creek, Pammel.

203. PHRAGMIDIUM SUBCORTICIUM (Shrank) (*P. mucronatum* Link).

Uredo and teleutospores on leaves of *Rosa parviflora* Ehrh., and on cultivated roses. Madison.

204. PHRAGMIDIUM SPECIOSUM Fries.

Teleutospores on petioles and stems of *Rosa parviflora* Ehrh., in fall and winter. Madison.

Uredo miniata P., or a form not to be distinguished from it, sometimes occurs on the same plant in spring under suspiciously similar circumstances, but a connection between the two species has not yet been traced.

205. PHRAGMIDIUM RUBI IDAEI (Pers.) (*P. effusum* Fckl., *P. gracile* Grev.).

Uredo and teleutospores on leaves of *Rubus occidentalis* L., in autumn. Madison.

This is the species distributed in Ellis' North American Fungi, No. 282, under the name of *P. incrassatum* Lk., var. *gracile*. The uredo which has been associated with it is very abundant, scattered over the lower surface of the leaves. It may prove to belong to *P. rubi* (Pers.) (*P. bulbosum* Strauss).

206. PHRAGMIDIUM FRAGARIAE (D C.) (*P. triarticulatum*, B. & C., *P. obtusum*, P.).

Uredo (*Uredo potentillarum* D C.) on leaves of *Potentilla canadensis* L. Madison; La Crosse, Pammel.

207. GYMNOSPORANGIUM MACROPUS Link.

Teleutospores common on cultivated *Juniperus virginiana* L., in May. Madison, Syene; Oconomowoc, Lapham; Sauk City, La-Crosse, Pammel.

GYMNOSPORANGIUM SABINAE (Dicks.), var GLOBOSUM Farlow (*G. fuscum*, D C., var. *globosum* Farlow).

Teleutospores on *Juniperus virginiana* L., common on certain trees in May. Madison; River Falls, King.

The galls of this species are less succulent than those of the last, which are commonly known as "Cedar Apples." Cornu records similar galls as caused by it in France (Bull. Soc. Bot. de Fr., v. 25, p. 123).

The common European cluster-cup of the pear (*Roestelia cancellata* Rebent.) is held to be a state of this species, but it does not occur with us, if, indeed, it is found in this country.

209. MELAMPSORA SALICIS CAPREAE (Pers.) (*M. salicina* Lév.).

Uredo and teleutospores common on species of *Salix*, the latter developing after the leaves have fallen. Madison; La Crosse, Pammel.

210. MELAMPSORA POPULINA (Jacq.).

Uredo very common in the fall, on leaves of *Populus monilifera* Ait., *P. tremuloides* Michx., *P. grandidentata* Michx. and *P. balsamifera* L., var. *candicans* Gray. Teleutospores on fading or fallen leaves of the same species. Madison.

211. COLEOSPORIUM SONCHI ARVENSIS (Pers.) (*C. compositarum* Lév., *C. solidaginis* Thuem.).

Uredo and teleutospores common on species of *Solidago* and *Aster*, in summer and fall, Madison; Dells of the Wisconsin, La Crosse, etc., Pammel.

ISOLATED UREDO FORMS.

212. UREDO MINIATA Pers. (*Coleosporium miniatum*, Pers.).

Very common on petioles and stems of *Rosa parviflora* Ehr., in spring. Madison; La Crosse, Pammel.

Precedes *Phragmidium speciosum* Fr., to which some of its forms bear a considerable resemblance in habit.

213. UREDO AGRIMONIAE EUPATORIAE (D C.) (*Coleosporium ochraceum* Bonord.).

Common, on leaves of *Agrimonia eupatoria* L. Madison.

214. UREDO IRIDIS Duby. (*Trichobasis iridicola* Pk!).

On *Iris versicolor* L., in fall. Madison.

215. UREDO PYROLAE (Gmel.).

On *Pyrola elliptica* Nutt., in spring. Madison.

216. Uredo, sp.

On *Mimulus ringens* L., in company with *Aecidium pentstemonis* Schw. La Crosse, Pammel.

Sori small, scattered loosely over both surfaces of the leaf; spores pale orange, very irregular, unevenly warted, 10×23— 15×16μ.

217. Uredo polypodii (P.) (*U. filicum* D C., *U. aspidiotus* Pk.?).

On *Cystopteris fragilis* Bernh., in May and June. Madison, Kilbourn City.

Spores obovate to pyriform, smooth, 13—20×23—26μ, usually, 13.5×25μ; thinner walled than European specimens on *Cystopteris* and *Phegopteris.*

218. Caeoma nitens Schw. (*C. luminatum* Schw.).

Common in spring, on wild and cultivated plants of *Rubus occidentalis* L. and *R. villosus* Ait. Syene, Stoughton, Madison; Baraboo, La Crosse, Pammel; Janesville, Kellogg.

The common red-rust of raspberries. The orange rust which occurs in autumn is referred to No. 205.

ISOLATED AECIDIAL FORMS.

219. Aecidium* pustulatum Curt.

On *Comandra umbellata* Nutt., in spring. Madison; Columbus, Rockwell.

220. Aecidium polemonii Peck.

On *Phlox pilosa L.* and *Polemonium reptans* L. Common, in spring. Madison.

221. Aecidium podophylli Schw.

On *Podophyllum peltatum* L., in June. Madison.

Sometimes associated with *Puccinia podophylli* Schw., which, however, more commonly occurs without any trace of the aecidium.

222. Aecidium oenotherae Peck.

Very common in spring and summer, on *Oenothera biennis* L. Stoughton, Madison; Baraboo, Pammel; Sauk City, Lüders.

223. Aecidium lysimachiae Lk.

On *Steironema lanceolata* Raf. (?) La Crosse, Pammel.

224. Aecidium solani Mont.

On *Physalis virginica* Mill. and *P. lanceolata* Michx. Sauk City, Lüders.

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* This name is sometimes written *Oecidium.* See Malinvaud, Bull. Soc. Bot. France, 1880, No. 5.

225. Aecidium petersii B. & C.

On *Viola delphinifolia* Nutt. Common, in spring. Madison.

Peridia longer than those of the aecidium of *Puccinia violae.*

226. Aecidium geranii D C.

Very common, in spring, on leaves of *Geranium maculatum* L.

227. Aecidium grossulariae D C.

On leaves, pedicels and flowers of *Ribes rotundifolium* Mx., *R. floridum* L'Her., *R. cynosbati* L., *R. aureum* Pursh and *R. rubrum* L. Everywhere, in spring. Madison; La Crosse, Pammel.

This cannot be distinguished from the European species, which is called by Winter the aecidium of *Puccinia grossulariae* Gmel., with which he identifies the American *P. pulchella* Pk. Though the aecidium is one of the commonest of fungi everywhere east of the Mississippi, I am not aware that its assumed teleutosporic form has been recorded for any locality but the one given by Peck. Dr. Magnus, also, writing of this species as it occurs in Germany, says "*Aecidium grossulariae* certainly is an isolated aecidium, which belongs to a heteroecismal *Puccinia*, as I convinced myself some years since by observations on *Ribes nigrum, R. grossularia* and *R. alpinum*, in the vicinity of Berlin." *

Since the above was written, Plowright, discussing British Uredineae, says: "As no *Puccinia* occurs on gooseberry leaves in this country, it is clear *Aecidium grossulariae*, as we find it, is not a Pucciniopsis but is probably a heteroecismal species." (Grevillea, XII., 36). the same conclusion is reached in Denmark, by Rostrup (Rev. Mycolgique, October 1884, p. 211).

228. Aecidium polygalinum Peck.

On *Polygala senega* L. Madison; La Crosse, Pammel.

229. Aecidium impatientatum Schw.

On *Impatiens fulva* Nutt. and *I. pallida* Nutt. Madison; La Crosse, Pammel; Sauk City, Lüders. Also collected at Hokah, Minn., by Mr. Pammel.

230. Aecidium jamesianum Peck.

On *Asclepias tuberosa* L., *A. cornuti* Dec., *A. ovalifolia* Dec. and *Acerates longifolia* Ell. Stoughton; La Crosse, Pammel; Sauk City, Lüders.

This is called the aecidium of *Uromyces howei* (Peck) by Mr. Arthur (Bull. Minn. Acad., XI., 25).

The bright orange-red spores contrast beautifully with the pure white peridia, much as in *Roestelia aurantiaca* Pk., and the thickening of their walls, mentioned by Mr. Arthur, is very characteristic.

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* (Verhandl. Bot. Verein. Prov. Brandenburg, v. 23, p. XXVII-XXVIII.)

231. AECIDIUM CONVALLARIAE Schum.

On *Polygonatum biflorum* Ell. and *P. giganteum* Dietr. La Crosse, Pammel. Spermogonia, probably of this species, on *Smilacina racemosa* Desf.

232. AECIDIUM SAMBUCI Schw.

On *Sambucus canadensis* L. La Crosse, Pammel.

233. AECIDIUM FRAXINI Schw.

On *Fraxinus sambucifolia* Lam. Kirkland, La Crosse, Pammel.

234. AECIDIUM RANUNCULACEARUM, D C.

On *Anemone dichotoma* L. La Crosse, Pammel.

This species includes, in part, the aecidium of *Uromyces dactylidis* Otth., which occurs on grasses, according to Schroeter and Plowright, while *Puccinia arundinacea* D C. also has its aecidium on *Ranunculus*, according to Cornu (Comptes Rendus, June 26, 1882).

To be distinguished is, perhaps—

235. AECIDIUM THALICTRI Grev.

On *Thalictrum dioicum* L. Madison; La Crosse, Pammel.

236. AECIDIUM RANUNCULI Schw.

On *Ranunculus abortivus* L. Madison, in spring.

Quite distinct in its habit from either of the preceding.

237. AECIDIUM PUNCTATUM Pers. (*A. quadrifidum* D C.).

Not uncommon on leaves of *Anemone nemorosa* L. Less abundant on *Anemone acutiloba* Lawson, in May. Madison.

The typical form with a wide 4-lobed margin is unusual, most of the specimens having a narrow border divided into small lobes. The form on *Hepatica acutiloba* is very distinct from *A. hepaticae* Beck, in its brown spores. I do not distinguish it from some forms on *A. nemorosa.*

238. AECIDIUM DICENTRAE, n. sp.

On leaves of *Dicentra cucullaria* D C., in company with *Peronospora corydalis* DeBary. Madison.

Hypophyllous, scattered. Spots none. Peridia short, pale yellow, irregularly torn or finely many-lobed, .3 mm. in diameter. Peridial cells granulated, polygonal, more or less isodiametric, averaging 13×15 μ. Spores deep orange, thin-walled, smooth, nearly spherical or somewhat polygonal; 13–20 μ, usually about 16 μ; wall colorless.

A beautiful species, collected by Mr. Pammel in May, 1884. The aecidia are accompanied by small violet or brown spermogonia, like those of *A. punctatum.*

239. AECIDIUM PAMMELII, n. sp.

On leaves of *Euphorbia corollata* L. La Crosse, Pammel.

Spots brown, little, if at all, thickened, slightly pustulate, with a central cluster of a few spermogonia. Cluster cups usually hypophyllous, concentrically arranged, rarely a few epiphyllous. Peridium short, whitish; border narrow, about 10-lobed. Peridial cells colorless, rugose, usually nearly isodiametric, 20–25 μ. Spores red-orange, polygonal, isodiametric or commonly somewhat elongated, 20—25 μ.

The spots are generally orbicular, or elliptical with the longer axis parallel to the midrib. When the spermogonia appear near the margin of the leaf, or near the midrib, the spot naturally develops in but one direction. The species differs from the aecidium of *Uromyces euphorbiae* C. & P. in the regular arrangement of the cluster cups on round spots, and from the other aecidia occurring on this genus in not deforming the host plant.

240. Aecidium pentstemonis Schw.

On *Castilleia sessiliflora* Pursh., *Pentstemon pubescens* Sol. and *Mimulus ringens* L., in summer. La Crosse, Pammel.

The aecidia occur most abundantly on the lower surface of the leaf, less frequently above. Spots rounded, slightly thickened, reddish-brown, often yellow-bordered; less evident on *Castilleia* than on the other hosts. Peridia white, short, scarcely bordered, crumbling into the rows of cell of which they are composed. Spores orange; smooth, 15--20 μ in diameter.

The form on *Pentstemon* seems to be *A. pentstemonis* Schw., and that on *Mimulus* is scarcely different from *A. gerardiae* Pk., but neither seems to be very distinct from *A. scrophularinarum* Lasch., on *Scrophularia*, in Rabenhorst, Herb. Mycol., Ed. 2, No. 374. A uredo (No. 216) occurs in company with the aecidium on *Mimulus*, but is not evidently connected with it.

241. Aecidium sii latifolii (Fiedler).

On leaves of *Sium lineare* Michx. La Crosse, Pammel.

242. Aecidium compositarum Winter.

On leaves of *Lactuca canadensis* L., *Nabalus*, sp., *Vernonia noveboracensis* Willd., *Eupatorium perfoliatum* L., *Aster sericeus* Vent. and several other species of *Aster* and *Solidago* (among the latter *S. latifolia* L. and *S. riddellii* Frank), *Silphium perfoliatum* L., *Erigeron annuum* Pers., *E. canadense* L., *E. strigosum* Muhl. and *Cynthia virginica* Don. Madison; Kirkland, La Crosse, Pammel.

In this conglomeration, which for convenience includes all aecidia found on Compositae and not connected with some teleutosporic form, are, perhaps, to be distinguished: *A. tenue* Schw. (*A. compositarum*, var. *eupatorii* Schw.), *A. erigeronatum* Schw. and *A. asteratum* Schw. Specimens found at Madison on *Taraxacum dens leonis* Desf. may prove to be *A. taraxaci* Schm. and Kze., the aecidium of *Puccinia silvatica* Schr., of which we have not detected the teleutospores.

243. Roestelia lacerata (Sow.).

Very common in summer and fall, on leaves of *Crataegus tomentosa* L. and *C. coccinea* L. Madison, Ithaca.

This is considered by European authorities to be the aecidium of *Gymnosporangium clavariaeforme* D C., which grows on the Juniper, but has not yet been reported in Wisconsin. Although the *Roestelia* is very abundant about Madison, I have never seen the Juniper here, so that its teleutospores are necessarily wanting.

244. Roestelia penicillata (Sow.).

Common on leaves of *Pyrus coronaria* L. and *Amelanchier canadensis* Torr. and Gray., the spermogonia in May and June, the cluster-cups later. Madison; Delton, La Crosse, Pammel.

Sometimes considered a variety of the last species.

245. Roestelia transformans, Ell.(?)

Spermogonia on leaves of *Pyrus arbutifolia* L. La Crosse, Pammel.

USTILAGINEAE.

246. Ustilago panici glauci (Wall.) (*U. neglecta* Niessl).

In ovaries of *Setaria glauca* Beauv. Very abundant in fall. Syene, Madison.

247. Ustilago sorghi (Link) (*U. tulasnei* Kuehn).

In ovaries of *Sorghum saccharatum* L., grown from imported Chinese seed. Madison.

The specimens are more elongated than the typical form, but hardly distinct. Dr. Farlow writes me that he has more typical forms from Washington, D. C. The introduction of the smut with Chinese seed is well shown by its occurrence in three distinct localities (District of Columbia, Farlow; New York, Sturtevant; and Wisconsin) on plants raised from imported seed. It does not seem to spread with us.

248. Ustilago zeae mays (D C.) (*U. maydis* Lév.).

In various parts of *Zea mays* L. Very abundant everywhere: also on leaves of the Teosinte (*Euchlaena luxurians* Fourn.) at Madison, and Cambridge, Mass.

249. Ustilago segetum Pers.

In ovaries of *Avena sativa* L., *Triticum vulgare* Vill. and *Hordeum vulgare* L. Madison; Sauk City, La Crosse, Pammel; Milwaukee, Lapham.

Very abundant; the small-grain smut.

250. Ustilago rabenhorstiana Kuehn.

In the inflorescence of *Panicum sanguinale* L. Madison; La Crosse, Pammel,

Spores smoother than the European form.

251. USTILAGO SPERMOPHORUS B. & C.

In ovaries of *Eragrostis poaeoides* Beauv., var. *megastachya* Gray. Madison; Sauk City, Lüders.

The affected ovaries are round or ellipsoidal, scarcely enlarged, and remain long unbroken, enclosed by the paleae. Spores thin-walled, brown, round or slightly elongated, finely echinulate, 6×8, 8×8 — $10\times8\,\mu$.

The appearance of the ovaries recalls *Tilletia decipiens* (Pers.) as represented in Scandinavian specimens as *Agrostis*, from Professor Blytt, but the spores of that species measure 23 — 28 μ.

252. USTILAGO JUNCI Schw.

Pedicels and perianth of *Juncus tenuis* Willd. (?) in June. Stoughton.

Apparently referrible to Cornu's genus *Cintractia.*

253. USTILAGO SYNTHERISMAE Schw.

Inflorescence of *Cenchrus tribuloides* L. La Crosse, Pammel.

254. TILLETIA FOETENS (B. & C.) (*T. laevis* Kuehn).

In ovaries of *Triticum vulgare* Vill. La Crosse, Pammel.

The "bunt" or hard smut of wheat, published in 1860 as *Ustilago foetens* B. & C., in Ravenel's Fungi Carol. Exsicc., V., 100.

255. TILLETIA STRIAEFORMIS (West) ? (*Ustilago salveii* B. & Br!).

In leaves of *Phleum pratense* L. and *Elymus canadensis* L., var. *glaucifolius.* Stoughton, Madison; La Crosse, Pammel.

Referred here on the authority of Winter.

256. ENTYLOMA COMPOSITARUM Farlow. (*Protomyces polysporus* Peck).

In leaves of *Silphium integrifolium* Mx., *Ambrosia artemisiaefolia* L., *A. psilostachya* D C. and *Lepachys pinnata* Torr. & Gr. Madison, Ithaca; LaCrosse, Pammel.

Occurs also on *Aster puniceus* L., in the East, and has been described on *Ambrosia trifida* L., by Peck (34th Report, pp. 45–6).

257. ENTYLOMA LOBELIAE Farlow.

In leaves of *Lobelia inflata* L. Delton, Pammel.

258. ENTYLOMA CRASTOPHILUM Sacc. (?)

In sheaths of *Zizania aquatica* L. Madison.

This agrees well with the description in all respects save the thickening of the angles of the spores, which I have not noticed. I have not been able to compare it with authentic specimens.

259. ENTYLOMA LINARIAE Schroeter.

In leaves of *Veronica peregina* L. Madison.

This occurs in round, thickened portions of the leaf, similar to those on *Linaria*, in which it is found in Europe.

260. ENTYLOMA BESSEYI Farlow (*E. physalidis* Wint., *Protomyces physalidis* K. & C.?).

On *Physalis*, sp. Madison; La Crosse, Pammel,

The description does not allow it to be distinguished from the African species described by Kalchbrenner and Cooke (Grevillea, IX., 22).

261. ENTYLOMA MICROSPORUM (Ung.).

On leaf and petiole of *Ranunculus fascicularis* Muhl. Stoughton.

262. ENTYLOMA MENISPERMI Farlow and Trelease.

In leaves of *Menispermum canadense* L. Madison; Hokah, Minn., Pammel.

263. ENTYLOMA THALICTRI Schroeter (?).

In leaves of *Thalictrum dioicum* L. Common in the fall. Madison.

This seems to be distinct from *E. ranunculi* (Bonord.), to which it was doubtfully referred by Farlow (Botanical Gazette, August, 1883). Having seen no description of Schroeter's species, however, I can only assume that the two may be identical.

264. DOASSANSIA ALISMATIS (Fr.).

In leaves of *Alisma plantago* L., var. *americana* Gray, and *Sagittaria variabilis* Engelm. Madison.

The young spots in spring are white, and look like those of an *Entyloma*. The conidia on *Sagittaria* are hyaline, cylindrical or fusiform, 1-celled, and measure 2–3×12–20 μ.

265. UROCYSTIS ANEMONES (Pers.) (*U. pompholygodes* Schl.).

In stems and leaves of *Anemone nemorosa* L. and *A. dichotoma* L. Madison; La Crosse, Pammel.

266. UROCYSTIS OCCULTA (Wall.).

In leaves of *Elymus canadensis* L. Stoughton.

267. ENTOMOPHTHORA MUSCAE (Cohn).

Very common, on house flies, in fall. Madison, Syene.

The common fall disease of flies. The tarichium state of *E. calopteni* Busey will probably be found here in the larger grasshopper (*Caloptenus differentialis*).

THELEPHOREAE.

268. EXOBASIDIUM VACCINII Wor.

On *Gaylussacia resinosa* Torr. & Gray and *Vaccinium*, sp. Kirkland, La Crosse, Pammel. Also collected on the last-named host at Hokah, Minn., by Mr. Pammel.

Undoubtedly occurs on the cranberry and other Ericaceae here as elsewhere.

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ON THE PRESENT STATE OF OUR KNOWLEDGE OF STELLAR MOTION.

By Truman Henry Safford, Ph. D., Field Memorial Professor of Astronomy in Williams College.

The stellar motions, the so-called proper motions of the stars, which used to be thought fixed, seem to us very small, because the suns we call stars are so very far away.

Bodies which move at least as rapidly as our earth does about its sun, seem to move with velocities rarely exceeding one second a year; and this large stellar motion is only sufficient to produce a displacement equal to the moon's diameter as we see it in about eighteen centuries.

Under these circumstances another cause besides the apparent slowness makes the problem in question a troublesome one — the fact, namely, that accurate astronomical observation is a thing of less than two centuries past — and even Flamsteed, who commenced it, is now antiquated — and we are obliged to take Bradley's later observations — from 1750 on — as the real beginning.

Moreover, as years go by, it is found possible and necessary to re-reduce the older star-catalogues, in order to make use of the past records to the greatest possible extent.

Thus Bessel's Bradley's catalogue superseded in 1818 Bradley's own catalogue; and Professor Auwers has already published the chief results of a new reduction, which, using Bessel's principles and methods, supersedes Bessel's results.

Another element of difficulty in the problem lies in the comparative ease of making new observations upon the stars in a routine way, and the greater difficulty of selecting the fittest objects and observing those only. The practical astronomer who has learned simply how to observe, is far inferior to him, whose ability lies in a combination of the power to select well his working list, that to observe to the last degree of accuracy, and that to discuss results with skill and completeness. And the German school of astronomers, established by Bessel, Gauss and Struve, is at the

same time the most perfect and the most regardful of all these matters.

At present star-catalogues are many; but complete discussions of their results are very scanty in comparison.

Three elements must then be considered in the present paper.

First, what old catalogues need re-reduction?

Second, what new observations need to be added to those now in progress.

Third, what discussions of stellar motion by the help of these materials are timely and needful.

Bradley's observations, as I have said before, have been re-reduced by Auwers; and his work is partly published; he has also taken care that new observations be made upon such of the stars as needed them; the resulting new catalogue by Dr. Becker of the Berlin observatory has been published, with proper motions discussed by Auwers; and Bradley's stars need not be observed any more for the present, except for purposes of the most refined accuracy. It will be an economy in by far the most cases simply to drop all Bradley stars from our working lists.

Flamsteed and Lacaille, from their want of precision, need hardly be considered in this connection; Lacaille's observations were, it is true, partly of some accuracy for his time; but *these* cases will mostly come up under other circumstances, as repetitions of Bradley; or else will be included in the Cape of Good Hope observations. Lacaille's far southern stars, whether well or ill observed by himself, are all continued in the new Cape catalogue.

T. Mayer (1756) observed zodiacal stars mainly. These are now in process of reobservation at Berlin.

Prof. Newcomb has lately prepared a catalogue of standard and zodiacal stars; so that the observer or computer who wishes to economize his labor had best avoid all stars within 6 degrees of the ecliptic; especially as the Greenwich observatory, and also that at Wilhelmshaven, so far as its means allow, are especially careful about stars near the moon's path from year to year.

The Lalande zones, including Fedorenko and D'Agelet,

have been or are to be reobserved in the great zones now going on under the auspices of the Astronomische Gesellschaft, an international association having its seat at Leipzig. This reobservation is certainly sufficiently accurate to compare with Lalande, whose single observations were made with less accurate instruments than would now be employed; and whose mistakes are many. His zones have been fairly well reduced; and the lamented von Asten has computed new tables of reduction for most of them.

Piazzi's Palermo catalogue of 7,646 stars for 1800 needs a new reduction. This would, however, be an enormous labor; there are nearly 100,000 observations. Ten years' labor of a skillful computer would at least be needed; and probably this is a very low estimate. The stars do not now need reobservation owing to the great zones just mentioned.

Groombridge's catalogue for 1810 of 4,243 stars needs also a revision. But this would be much easier, as the original manuscript calculations are preserved; and are probably very free from mistakes. What is chiefly needed here is a careful study of the azimuth correction of Groombridge's meridian circle.

William von Struve published a catalogue of right ascensions for 1814 and 1815 in the first volume of the Dorpat observations. This, probably, needs some little revision, owing to its early date; and the same eminent observer continued this work during 1818 and 1819; but these latter observations are unreduced.

Years' work might readily be spent upon these right ascensions of Struve; and would be important for the revision of Groombridge, as the latter would be for that of Piazzi.

I have myself in progress a careful reobservation of the stars observed by Struve, especially for the difficult region within 10° of the north pole.

From the Greenwich observations of Bliss and Maskelyne, not much can be obtained for the stars' places. The planets, sun and moon, were the main subjects of Maskelyne's attention. S. Hertzsprung has reduced some of Maskelyne's work upon small stars, and I am myself calculating some more of it for another purpose.

But Pond, who was Astronomer Royal from 1811 to 1835, has left vast folios of observations; a good many of them need a new reduction and discussion. It may, perhaps, be hoped that the Greenwich authorities will accomplish this work at some future period; it is probably not immediately pressing.

Bessel, at Königsberg, accumulated a great store of observations. Among them is the material for a considerable catalogue of zodiacal stars, which a year's work would perhaps complete ready for press. It is all indexed and its mean epoch would be 1830 or 1835. The stars contained in it are also mostly in Piazzi and Mayer; but Bessel's observations are so much better than these as to make up for their comparative newness.

Something can also be made out of the same great astronomer's work between 1814 and 1819 although, his instruments were then very inferior to those employed later.

Another very useful, though very scattered, collection of older star-places, mainly declinations, could be made up by a careful study of the early latitude work of various astronomers from Mudge and Lambson, down to Bessel, Gauss and Struve.

Struve's great Dorpat catalogue, published in 1852, but containing results of observations back to 1822, has been, I believe, completely reobserved at Pulkova. So far as the other catalogues for epochs about 1830 are concerned, I fancy few of them need much reobservation; as they largely contain identical stars.

A few stars in the Abo catalogue (Argelander's of 1830) need reobservation as well as rediscussion. My own copy of this catalogue once belonged to the lamented Tiele, an assistant at Bonn; and contains manuscript notes of results — apparently calculated under Argelander's direction, which are nowhere else published as far as I know. The doubtful stars are in all cases such as were imperfectly observed before Argelander, and so mentioned in his notes.

There is a class of several hundred stars which, although visible to the naked eye, were only found in Lalande's and Bessel's zones when Argelander placed them in the Urano-

metria Nova. These were soon after observed by Henderson at Edinburgh, and by the Pulkova astronomers. They are much needed for field work in latitude and longitude. I have myself often missed accurate modern places for them, and hope to see them soon catalogued. The Edinburgh catalogue of Henderson is excellent in general plan, but is yet unfinished. The astronomer who shall put it together from the yearly volumes of 1834 to 1844 inclusive, will accomplish a considerable service at comparatively trifling cost. And these places begin to be old enough to serve as an old catalogue. The great Pulkova work of the same character is vigorously in progress, and will be soon completed.

The old catalogues, then, which need re-reduction or compilation, are these, with their epochs:

Piazzi, much the largest of all	1800
Mayer	1756
Groombridge (revision)	1810
Struve, circumpolar	1815
Pond (revision and recalculation)	1830
Bessel, zodiacal	1830
Miscellaneous latitude stars	1785–1830
Edinburgh (compilation)	1840

Of new star catalogues to be made I think the most important, next to the great zones several times mentioned, which are now nearly done for the northern hemisphere, is an accurate reobservation of all stars to the seventh magnitude inclusive, which are not now well known.

For the region south of the celestial equator there need be little solicitude in this matter, as the powerful observatories of the Cape, Melbourne and Cordoba have probably so nearly filled the gaps left at northern stations, that we can afford to wait till the results to date are completely published for the two latter ones. And the extension to the Tropic of Capricorn of the northern zones will show what farther is acking.

North of the equator, the stars of the first four magnitudes are nearly all Pulkova fundamentals, and thus well known, even where occasionally neglected at other places. Those of the fifth and sixth magnitudes have either been, or

are about to be, carefully observed at Greenwich; our Coast Survey has requested a few specially neglected ones of these degrees of brightness to be attended to at three or four places.

It may then be said that those astronomers who wish to contribute to our knowledge of bright stars' places, have only to supply such observations as they themselves use for semi-fundamental purposes, and observe stars of the *seventh* magnitude; and a few brighter which may have been neglected.

I have not yet mentioned the British Association Catalogue. This was published in 1852; its places and proper motions were then inaccurate, and are now relatively much worse, as great improvements have since been made in precision of observation. But the stars of this catalogue have been greatly preferred in observatories, owing to its great convenience as a working list; so that the general result now is, that an astronomer who wishes to do anything not superfluous, or liable soon to become so, must be very wary in his work upon these stars.

I have myself long kept an index of them, showing where and when their positions have been lately determined; and have thus saved myself much labor. The index is not quite complete, even for the northern hemisphere; a considerable portion of it is virtually published in my catalogue of 2,018 stars (Washington, War Department, 1879), and my manuscripts of the remainder are in such condition that I can readily give authorities for any B. A. C. star north of the equator.

When the great zones are published (this is to be expected to take place in portions for the next ten years), they will contain comparisons with several old authorities, and will thus indicate many new stars whose proper motions are to be looked for. They will consequently be referred to for this purpose by every one interested in this subject.

Of least square discussions of this subject, published in full, we have principally Mädler's Bradley, vols. 14 and 16 of the Dorpat observations, and volume 7 of the Bonn observations, which contains two long memoirs by Argelander.

Mädler's Bradley is in the main superseded by Auwers' but is often convenient to refer to as an index and approximate check for such stars as were defectively or poorly observed by Bradley.

Argelander's papers are indispensable to any one who wishes to master the subject; they have been excelled in small details, hardly in general plan. The miscellaneous list of considerable proper motions which the great astronomer here gives deserves occasional reobservation, as many of the stars were poorly observed before him.

There are four large catalogues lately published by four departments of the United States government, viz.: Mr. Boss's declinations of 500 stars, by the State Department; my own catalogue of 2,018 stars, both right ascensions and declinations, by the War Department; Prof. Newcomb's, of 1,098 stars, by the Navy Department; and the Coast Survey list of 1,463, by the Treasury Department. The first is admirable in all respects; Prof. Boss took a great deal of pains and spent much time; but the right ascensions are lacking. My own work was for a practical end, which did not allow either the means or the time for so complete a discussion of four times as many stars; but I think a great many trustworthy proper motions were detected by its means. I hope by-and-by to observe the few stars in this catalogue which are now at all uncertain, owing to lack of older observations. Prof. Newcomb's catalogue is, for the smaller non-fundamental stars, much in the same condition as my own. The coast survey computers have contented themselves with the rather inaccurate proper motions of the B. A. catalogue, and with a rather defective collection of modern authorities; so that the present errors of their declinations are large. They do not add right ascensions more accurate than to whole seconds of time, which is, of course, entirely proper for their purpose. In order to completely utilize for theoretical purposes the three government catalogues first mentioned, Mr. Boss's needs to be completed by adding right ascensions, and the other two — in fact all three — by revisions wherever the material at hand was deficient.

In the southern hemisphere, and especially in the southern-

most half of it, there are valuable discoveries by the Melbourne observers and by Mr. Stone; and in the northern hemisphere, and part of the southern, we have Auwers' Bradley and the other compilations which have been just mentioned. I estimate that probably two thousand stars in the whole heavens have proper motions exceeding 0″.1 (a tenth of a second) annually, which have already been calculated by least squares, or some similar process, and only need revision.

The field of investigation in this direction now open is, of course, boundless; what needs to be done for the next twenty years is mainly a critical study of the materials, their reduction to a fixed epoch and least square calculation therefrom, and adding (probably) a smaller amount of new observations than has been accumulating in a routine way, without much plan, for the last half century; to say nothing of the great catalogues which have been better planned. I have not mentioned these newer catalogues in detail as they are well known.

For the epoch 1900 it ought to be possible to construct a catalogue like that of the British Association for 1850 in general plan, but complete to the seventh magnitude, and of great accuracy both in its positions and proper motions, and before that time we ought to have a definitive settlement of the problem of the solar motion, which will go far to give us definite notions of the general structure of the universe. For I have long ago shown that, in this way only can we find much more about the average stellar distances.

FOURTEENTH ANNUAL MEETING.

DECEMBER 26, 27 AND 28, 1883.

PROGRAMME.

WEDNESDAY, DECEMBER 26th, 7:30 P. M.

Business Meeting — Reports of Officers.

THURSDAY, DECEMBER 27th, 9:30 A. M.

Unfinished Business.

Paper: "On Ancient Villages among Emblematic Mounds."—Rev, S. D. PEET, Clinton.

Paper: "On Elephant Mounds."—Rev. S. D. PEET.

Paper: "Game Drives on the Mississippi River."—Rev. S. D. PEET.

Paper: "The Man Mounds."—Rev. S. D. PEET.

AFTERNOON SESSION, 2:30 P. M.

Paper: "On the Distribution and Migration of Birds in Outagamie and Brown Counties."—S. D. WILLARD, Depere.

Paper: "On the Principal of Duality."—Prof. C. A. VAN VELZER, Madison.

Paper: "Analysis of Water from Florence, Wis." PROF. W. W. DANIELLS, Madison.

Paper: "The Wisconsin Geological Survey on Upper Silurian Fossils." Dr. F. N. DAY, Wauwatosa.

Paper: "Variation in Attraction due to the form of Attracting Bodies." D. P. BLACKSTONE, Berlin.

EVENING SESSION, 7:30 P. M.

Unfinished Business.

FRIDAY, DECEMBER, 28th, 9:30 A. M.

Paper: "On the Driftless Area."—Prof. R. D. SALISBURY, Beloit.

Paper: "On Metamorphic Rocks."—Prof. R. D. IRVING, Madison.

Paper: "The Variation in Attraction due to the form of Attracting Bodies." D. P. BLACKSTONE, Berlin.

AFTERNOON SESSION, 2:30 P. M.

Paper: "On the Relation of Greek Art and Religion."—Prof. J. EMERSON, Beloit.

Paper: "The Democracy of the Ancient Germans."—Prof. W. F. ALLEN, Madison.

Paper: "The Results of the Caroline Id. Eclipse Expedition."—Prof. E. S. HOLDEN, Madison.

Paper; "The Genera of the Family Attidæ."—Prof. G. W., and ELIZABETH S. PECKHAM, Milwaukee.

ANCIENT VILLAGES AMONG EMBLEMATIC MOUNDS.

Rev. S. D. Peet, Clinton, Wis.

The subject which the author has set before himself in the heading of this paper, is an important one and yet one which is attended with peculiar difficulties. It is not an easy task to take the silent monuments of the dead and to people them with a living race. Even historic scenes when once deserted and left in silent ruin are difficult to rehabilitate, but prehistoric scenes much more. Of all the prehistoric works none are more mysterious and difficult to explain than are the emblematic mounds. There is an obscurity about them which almost baffles investigation. The people who built them are shadowy and unfamiliar as ghosts. For one to enter into the study of their habits and ways and to describe their modes of life is almost presumptuous. The tokens are, however, before us. Other explorers have studied monuments and from them given descriptions of unknown people.

The villages of the emblematic mound-builders may, indeed, be different from the buried cities of the east and their village life may contrast with the civilized state; yet this is in accord with what is known concerning the mysterious people. We are not to consider them as a civilized race, but rather as a rude and almst savage people. Their villages are merely the habitations of a rude people and are to be studied as much in their connection with their surroundings, as in the works which are found upon their village sites. This point will be considered by the reader as he follows the line of thought, for there are many elements brought into the account and they are all to be as exponents of the one surrounding system. The treatment of the subject is mainly from an archaeological standpoint. The only object of comparison is the villages of the later Indians. These, however, differ so much in their tokens from the villages of the earlier race, that they become sources of confusion and close anal-

ysis is required to distinguish the two classes of works. The author has been careful to notice the differences between the two and to make the subject definite. Our investigation is to be among emblematic mounds and not other tokens and the villages of which we are to speak are the villages of this unknown people. There are several heads or divisions to the snbject:

I. The existence of village life among the emblematic mound-builders.

II. The probable characteristics of these villages.

III. The identification of these peculiarities or traits in certain localities.

IV. The comparison of different localities as exhibiting the same characteristics.

V. The contrasts which are presented by certain groups, concerning which there are doubts whether they contain village sites or not.

I. The existence of village life among the emblematic mound builders is a point which has very great interest, and which deserves especial attention. The proofs of this have been lacking hitherto, although there are many facts which have rendered it probable.

(1). In the first place it has been supposed that the mound builders were in that stage of culture which would render the village a necessity. They were passing out from the stage of savagery and from a purely hunter's life into the agricultural state. This is evident from the fact that garden beds are found associated with the mounds. These garden beds differ from the corn fields of the Indians as much as the elaborate works and effigies differ from the ordinary burial mounds, and show that the mound builders were superior to the later tribes.

Village life existed among the Indians. With them there was the custom of raising the cereals combined with the chasing of wild game and the subsistence upon fish. With the mound-builders the same modes of life may have prevailed, but village life would be more marked, inasmuch as their culture was more advanced. The relics which are found, as well as the works, indicate that a peaceable condi-

tion prevailed among the builders of the emblematic mounds. These relics have been discovered in various parts of the state, and show that the copper age had been reached by this unknown people. We do not say that the copper age and village life were identical, but there was an approximation to the bronze age, and we know that the bronze age was characterized by the prevalence of villages. Mining was probably known to the mound-builders, and this would render probable that village life had been reached.

(2). Again, the tradition and known customs of the later tribes would render it probable that the mound builders dwelt in villages. The remark of Miss Fletcher in reference to the Dakotas is that they have favorite places to which they resort for generation after generation, and, judging from the tokens furnished by the emblematic mounds, we should say that the same custom prevailed among them. Village life is known to have existed among the Indians of this very locality, where the animal mounds are found. There are many sites of villages which have been identified by history. These differ from the sites of the villages of the preceding race, but are often in the vicinity of extensive groups of emblematic mounds. The record of early explorers and travelers is that the natives dwelt in villages, and the early maps locate these villages.

(3). The succession of races betokened by the earthworks would show that village life had existed in the earliest period. It is sometimes the case that the village site of a later tribe will appear with a certain class of earthworks in the vicinity, which differ from the works which belong to the emblematic mound builders, yet render it probable that both people built their mounds near their villages. It is one point for the archæologists to decide while studying the mounds and earthworks, which works belong to the later Indians and which to earlier mound builders.

(4). The universality of village life among uncivilized races would prove that it existed among the emblematic mound builders. This is a point which we shall not stop to discuss, but shall take it for granted. The similarity of village life is the point which we are to

examine. In reference to these there is, perhaps, more uncertainty than in reference to the existence of villages. The study of the native life of the wild tribes may furnish us some information in reference to their characteristics and from our knowledge of the later tribes we may ascertain what were the elements of the village condition, but it is mainly by analogy that we predicate that such elements existed among the mound builders. We carry with us information from the living races to the extinct and by one picture learn to interpret another filling up the outlines which have become obscure by the wear of time and interpreting many things which would otherwise be inexplicable.

Again, II. The characteristics of village life are exhibited or made known. These characteristics are as we have seen, the selection of a locality favorable to subsistence, the selection of a spot which would be convenient of access, well guarded by its natural surroundings, and which should be dry and favorable for the erection of houses. The tokens that a village was located would be found in the existence of mounds, earthworks and effigies around an enclosure, in such a position as to give the idea of defense. The additional discovery of caches, springs of water, and other signs of permanent residence, would be additional proof. The existence of burial mounds in the vicinity of outlooks which might serve as defenses and of altar mounds in the vicinity, would prove that the locality had been occupied as a place of residence. The existence of game drives and of trails and gardens would be still further evident. The early explorers and travelers all speak of villages. It is very seldom that Indians were met with outside of their villages, but there were many localities where villages were prevalent. The early maps have given the location of many of the villages. According to these maps the villages were situated on the water courses and lakes, and were connected to one another by trails. Several villages were situated on Green Bay, others on Lake Michigan, and still others on the Mississippi river.

The study of these villages may give to us some hints as

to what constituted village life. We find striking analogies between the locations of the earlier and the later races, for the same places in which history describes villages to have existed contain many monuments, which were evidently works which belonged to the emblematic mound buildess. The centers of population were the same and the same spots were chosen for the residences of the two races. The exploration of the mounds reveals a striking similarity between the modes of life and in many places should seem that these modes were carried out in exactly the same places; the hunting grounds being the same, the village sites the same, the defenses by lookouts the same, the burial places in close proximity and all of the departments of life having been conducted in the same scenes and having been repeated by the two races. The only difference between them being in the emblematic character of the mounds which the earlier race erected. The characteristics of the villages of the earlier race we conclude will be learned from the description of those of the later races.

The early travelers and explorers found Indians dwelling in villages, and from their descriptions we learn the characteristics of village life. These characteristics are as follows: 1st. The selection of a locality favorable for hunting and fishing, and at the same time accessible by rivers and trails from other villages and from distant parts of the country. 2d. The selection of a favorable spot for residence and the erection of houses or huts on some rise of ground overlooking a stream or lake. 3d. The erection of certain defenses, either stockade or a lookout station. This was a general habit, although there were many villages in Wisconsin which had no stockade and no visible defense. As a substitute, however, the villages were placed on land somewhat remote from the water course, and so hidden by surrounding forests or hills that they could not be approached without due warning being given. 4th. There were generally near these villages burial places, either the rude structures or graves protected by logs or rude planks, and the hollow logs hung in trees near the stream or lake. 5th. There were generally near the villages garden beds or corn fields, and

always springs of water. 6th. In certain localities there were arrangements or contrivances constructed from wooden stockades by which game were entrapped. This was not universal, but there are certain sketches in certain books, especially in Champlain's works, which illustrate the fact. The Indians of Wisconsin are not known to have constructed game drives, but the point is an interesting one. 7th. There are various traditions in reference to the attachments which the Indians had for the localities where the villages were situated, and in reference to the religious ceremonies which were observed in or near their villages. These seven particulars we have here mentioned, because they illustrate certain points which we have discovered in connection with the emblematic mounds. The identification of a village site surrounded by emblematic mounds, has led to the discovery of the same characteristics, and proves interesting on this account. The mere discovery of a village site would not avail much were there not some further information gained from it. In describing the villages of the emblematic mounds, we shall draw the comparison and speak of the specific items or elements which seem to have been common among the villages. We shall first refer to one particular village and then show what its characteristics were and then draw the comparison between this particular village and other supposed villages and from the aggregate draw conclusions in reference to what constituted village life.

The identification of a village site among the emblematic mounds is an interesting fact,and one worthy of notice in this connection. In the first place it proves that the mound builders dwelt in villages. This has indeed been rendered probable by other facts, but has not been hitherto proved for a certainty. In the second place it furnishes a clue to a certain class of works which have been supposed to mark village sites, but concerning which there has been also much uncertainty. These works have been discovered by the author in various localities and the conjecture has often arisen that they were village sites. The comparison between them and the works which are known to have surrounded a village now clears up the uncertainty.

The identification of certain village sites will next engage our attention. The method which we have pursued in identifying these sites is the one which we have already prescribed. We have fixed in our mind what was the probable characteristics of village life and then have studied the mounds to see if these characteristics could be found in them. We have, in fact, taken the picture of native society as we have ourselves painted it and then have sought a frame for the picture in the emblematic works. This is, in our opinion, the only way in which a village site could be identified. It was because we had framed some conception of the people who erected the mounds and from the study of their works had come to understand something of their mode of life that we have made the discoveries which we have.

The first place where a village site has been identified by the writer is at Great Bend, on the Fox river, thirty miles west of Milwaukee. Here is a series of works which Dr. Lapham has described, and which have proved to be interesting on many accounts. (1) A few words in reference to the locality will be in place. Great Bend is situated at the edge of the extensive forests which formerly stretched along the lake shore, throughout the whole length of the state. At a point where the extensive system of prairies which characterizes the scenery of the interior of the state intrudes upon the forests near this place is an extensive marsh, wherein are immense tracts of land filled with wild oats. There are upon one side of the stream forests which abound with game, especially with the beasts of prey and with the larger class of birds, such as the wild turkey, wild goose, hawks and eagles. On the other side are the prairies, where formerly abounded the grazing animals, such as the buffalo, elk, wild deer, and the great variety of prairie birds, the marsh and the river forming a favorite resort for ducks and wild geese, and water fowls of various kinds. There are in the vicinity many small streams and ponds where beaver and muskrat would be numerous. The locality is, then, a favorable one for the permanent residence of a people.

The character of the region can be learned from the map which we here present.

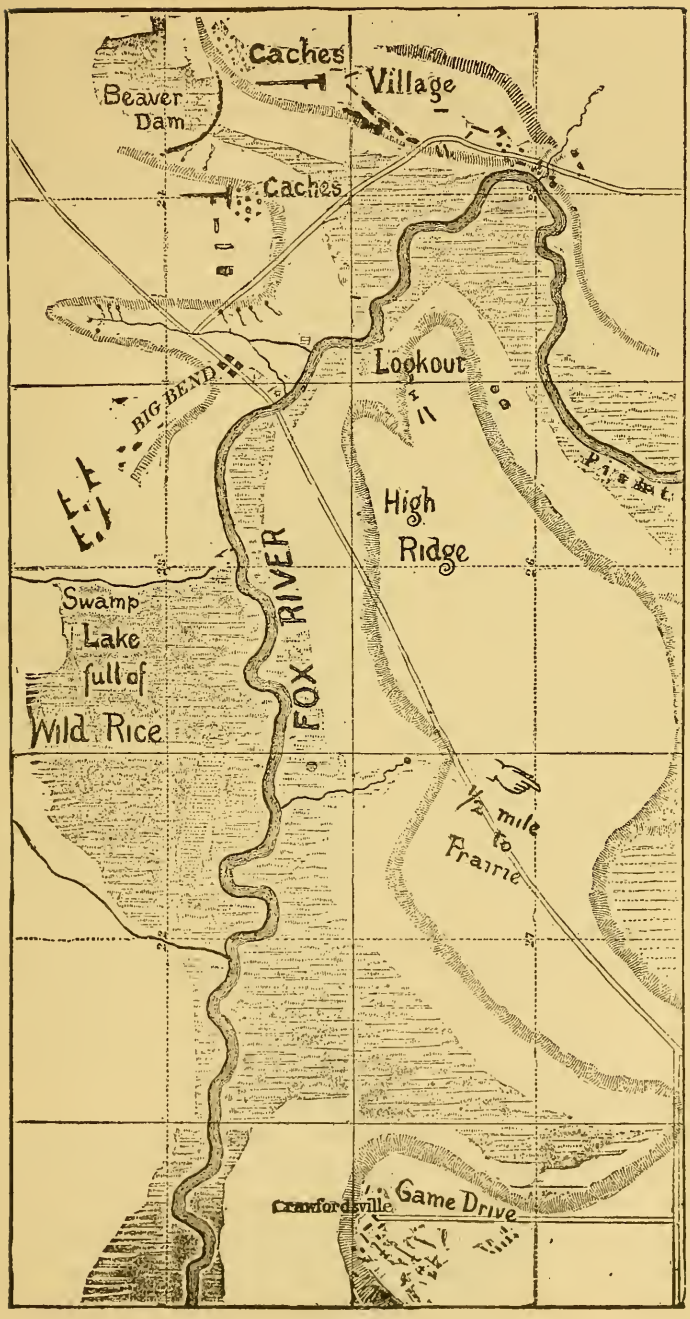
Caches
Village
Beaver
Dam
Caches
Lookout
BIG BEND
High
Ridge
FOX RIVER
Swamp
Lake
full of
Wild Rice
½ mile
to
Prairie
Crawfordsville
Game Drive

Fig. 1.

Another point worthy of notice is that in the vicinity there are high lands which command extensive prospects. At this point there are extensive ridges which form prominent points from which extensive views could be gained. The geological formation is here noticeable. The Great Bend was caused by the damming up of the stream in the glacial period by great ridges of gravel which turned it from its course, deflecting it to the eastward, for six miles or more. At the point where the village is located the river bursts through the barriers, leaving a high knob of land upon the west side and gentle swells of ground upon the east, making an extensive lake, or reedy and marshy place to the north of the ridge, and throwing the region to the south open to the ravages of fire, so that the prairie crept up to the very edge of the stream at that side. On this ridge there are mounds and earthworks which correspond to altar mounds and outlooks which have been discovered elsewhere. In approaching the locality from the north one is impressed with the sightliness of this bluff or ridge, for at many intervals the ridge can be seen several miles away. It is singular that as the writer approached it there were open spots in the wooded hill top which attracted special notice, and that these spots proved to be the very localities where were outlooks and sacrificial mounds.

On reaching the locality the first thing which attracted attention was the discovery of a panther effigy of remarkable size and well defined shape. (See Fig. 2.) In following the outline of the effigy and reaching the head, it was discovered that the land was broken by a great number of pits, which proved to be the caches of the village. These were situated on the edge of a small pond, and near a beaver dam, but were hidden away in the forests and would not have been noticed except for the proximity of the effigy.

There are many effigies which seem to guard caches as this does, but none had so far been discovered near any village site. Dr. Lapham describes one as situated at Indian Prairie. Here the effigy is represented as guarding a low mound. In the mound was a pit and upon the surface of the soil were corn hills. The figure is given herewith for the

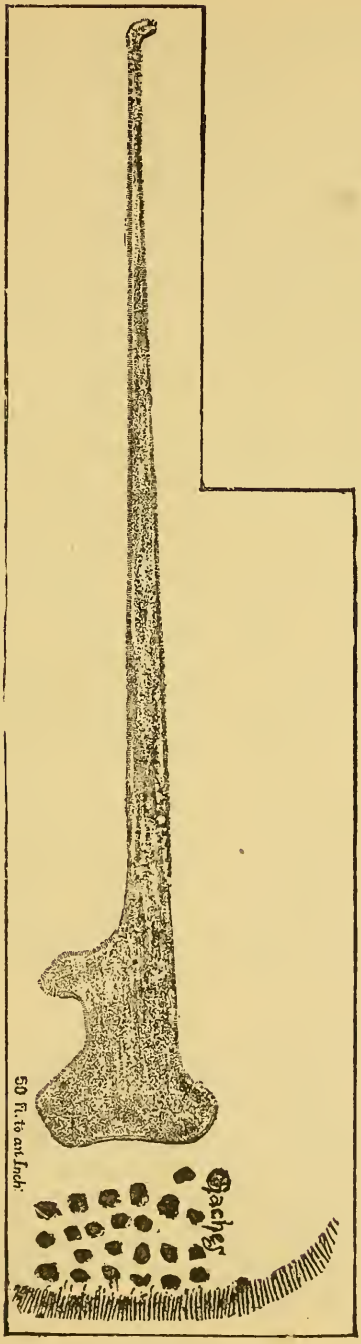

Fig. 2

sake of comparison. The effigy of a panther guarding the caches at Great Bend is much more symmetrical than that at Milwaukee. Dr. Lapham says that this ground is covered with a present race of Indians who occupied the land in this vicinity down to a very late period. The figure may be considered as a rude representation of a wolf or a fox guarding the sacred deposits before it. Both of these are of so little elevation as to be observed by the passer-by. The body of the animal is 44 feet and the tail 63 in length. The effigy which we discovered as guarding the caches near the beaver dam was accompanied by several large platforms o long mounds. One of them at right angles to the body of the effigy and another several rods distant to the west; these two having a parallel position. The caches were very observable. There were twenty or more of them scattered over the surface of the hill, but all of them in front of the effigy. Passing over the small stream where was formerly a beaver dam we came to other caches similarly situated, but without any effigy near them. These were more numerous than upon the other side, but were fully as well as guarded, as they were hidden in the forest and were in the rear of a rise of ground, on which we afterward discovered the site of the village itself. The existence of these caches was to us significant for it betokened permanent residence. We have previously noticed the advantages of the locality. The forest, and marsh, and prairie combined would lead one to expect a village somewhere in the vicinity. The fact that extensive works had been described also led to expectancy but the discovery of the caches put us on the alert.

(4) The situation of the village itself impressed us more than the caches. It was on a rise of ground from which the water flowed in every direction. The stream which we were crossing formed a barrier upon the north side. The swale and beaver dam and low land in which the stream headed formed also a barrier to the spot on the east, separating the village from the forests, making the approach to it inaccessible on that side. The river is some distance to the west, and flows at an angle toward the tongue of land on which the

village is situated. Between the village and the river the land is low, and so the spot is inaccessible except at one point. At the south of the village site was another small stream, which also heads in the swamp or springy land in the rear of the village. The low land adjoining is covered by a jungle of bushes and small trees, a fit place for the hiding of wild animals, but abounding with berries and wild fruit of various kinds. The situation of the village on this rise of ground was remarkable, because the spot was so favorable in every respect. The peculiarity of the site is that all the requisites of village life were furnished by it. It is well guarded and drained, is surrounded by forests and prairies, is well situated in relation to the river, the rice swamps, the beaver dam and springs of water, was in a locality where the means of subsistence were furnished in great abundance. Additional to these advantages was the fact that, on the opposite side of the river, less than a mile away, is the high bluff to which we have referred, and on this bluff there proved to be mounds which undoubtedly served as outlooks. The protection of the village was thus secured by the locality as well as the means of subsistence. The situation of the ground on which the village was located was in the midst of swamps and low lands, which also served for protection.

The evidence that this was a village site is as follows:

(*a*.) The selection of the locality with a view to subsistence. The place for storing grain was furnished by the hillside to which the approach was easy from the village itself, but was difficult from any other direction. The presence of springs near the village but in the rear of it secured to the inhabitants a supply of water from which they could not well be cut off. The presence of the game-drives shows that the inhabitants depended upon wild game as well as the products of the soil for their subsistence and the marshes in the vicinity abound in wild rice. There may have been the cultivation of maize, but no garden beds have been discovered in the vicinity. The means of subsistence were furnished by the forest, streams, lakes, and prairies.

(*b.*) The beauty of the spot and the advantages furnished by the well-drained and shaded ground would indicate that it had been used as a village site. Not all villages are as favorably situated as this, but the advantages were too manifest for any one to deny them in this case.

(5.) The artificial works of the locality impressed us. The first object which engaged attention was the effigy of a huge panther. This was situated on the edge of the hill at a point where the small stream breaks through into the valley of the Fox river. The effigy stretches along the brow of this hill overlooking the valley of the river, its immense body and tail forming a guard against approach to the caches on the banks of the stream above, and protecting the village site at this point. The effigy is a peculiar one; it represents the panther as standing with head erect, the legs straight, but the body extremely attenuated, as if the animal was in the last stage of starvation. The position of the effigy was also peculiar, while its immense body and tail stretched along the hillside toward the little stream at the north, and terminated at the very edge of the bluff in this direction. Its head fronted the opening to the village itself, and the attitude was as if the animal was looking directly into the village, and was there watching and waiting for some object that might satisfy its appetite. Such at least was the impression made upon the imagination by the figure. The contrast between this effigy and the one guarding the caches in the rear of the village was marked. In the first place the effigy was much longer and more definitely marked. Again, it was situated on the brow of the hill, overlooking the land adjoining. Its attitude and shape were peculiar. Our conclusion was that the effigy was stationed near the village site, with the head fronting the opening, in the attitude as if guarding the gateway.

At the entrance of the village site there was a series of oblong mounds. These mounds were arranged so as to make a double guard; two of them formed an angle toward the north, at the opening of which was the panther effigy two others formed an angle to the south, leaving openings at either end and between them, but so arranged as to form

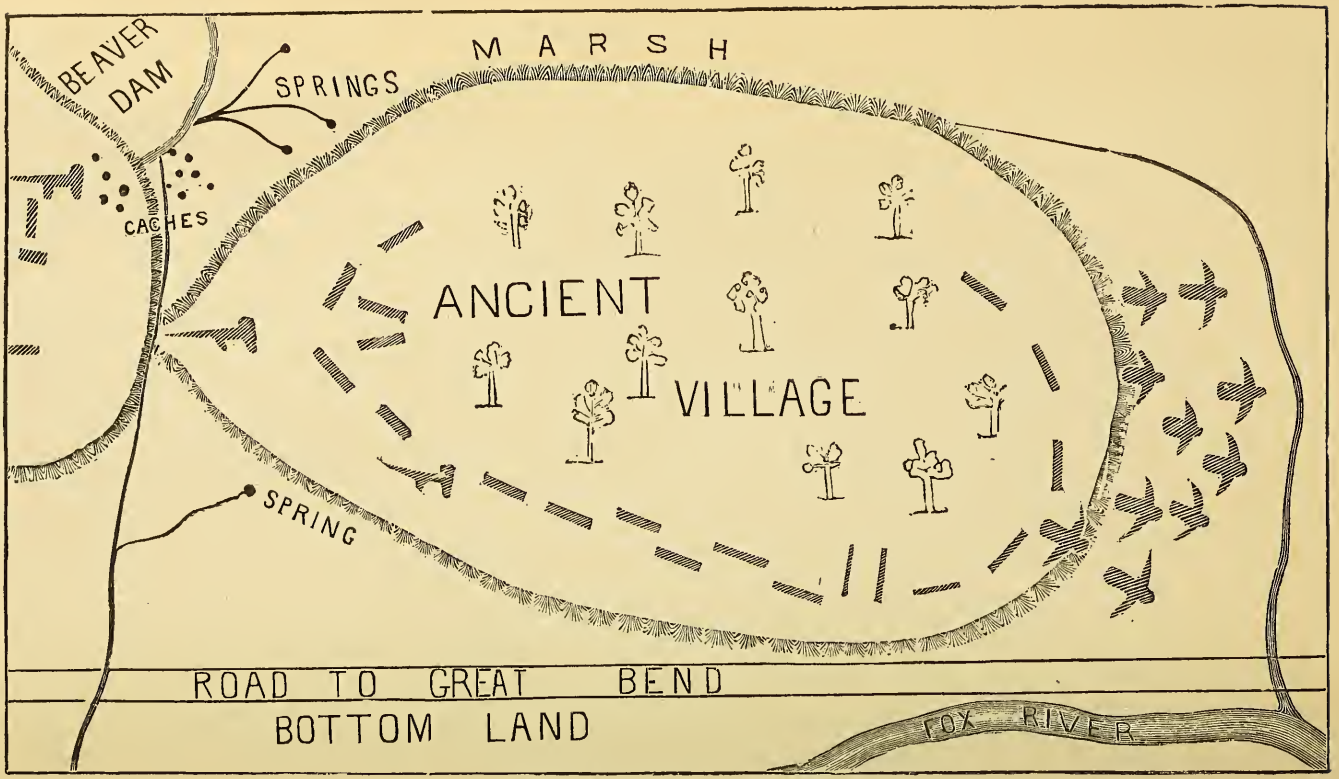

Fig. 3.—Mound Builders' Village.

a guard to the entrance; beyond this, following along the brow of a gentle slope of land were other oblong mounds. A little further on to the south and west was another panther effigy, the effigy this time situated at an opening between the oblong mounds, but with the body running parallel with the mounds, and thus forming a guard across the opening on the other oblong mounds and effigy mounds. Here the effigy was that of an eagle or hawk which seemed to guard the village on this side, and formed the bend of the wall. Other oblong mounds were situated on the edge of the rise of ground, forming a quasi wall at the south of the enclosure, and turning back toward the north formed also a partial wall upon the east side. The situation of the village was on a rise of ground within the enclosure, which was formed by the oblong mounds. There was no evidence of a stockade, but the earth-works so surrounded the village and site that they may have served as a partial defense. The entrances to the village were also guarded by mounds which were peculiarly arranged. The one where the panther effigy was had a double line of oblong mounds; the middle entrance was also guarded by oblong mounds, but had no effigies near it.

The means used for defending the locality prove that it was a village. The enclosure covered an area of about one hundred and sixty acres. The mounds surround the edge of the enclosure forming a fragmentary wall. They needed only to be attended with stockades to form a splendid defense against approaching enemies on three sides, while on the other side the marsh and low land furnished a natural defense. There was a double advantage or use to these oblong mounds, while they furnished platforms from which warriors could shoot approaching enemies. They also furnished platforms on which the inhabitants could sit and watch the busy life of the village within the enclosure. The entrance and covered ways would indicate that there was a form of arrangement of the houses, possibly streets ran through the villages, and a square may have existed in the centre. Effigies guarded the village at either side and gave the village the sense of protection. (See Fig. 3.)

The spot where the village is located is a beautiful one. It is at present covered with a sturdy growth of oak trees and is a very attractive place. The shade of the trees protects the spot from the glaring heat of the sun during the warm seasons, end the surrounding forest would protect also the village from the sweeping winds and drifting snows during the cold season. The presence of the caches and of the effigies and oblong mounds show that it was a permanent dwelling place. As an additional protection to the village, there were at the south of the village site a large number of bird effigies. These are scattered over the surface of the hill at this end of the village forming an abatis which might serve both as a screen for hunters and as a guard against the approach of an enemy.

The discovery of burial mounds in the vicinity indicated also that it was a place of permanent residence. These burial mounds were on the lowland adjoining the river. They are so situated that they form an outlook along the valley of the stream, but are in close proximity to the village site itself. These mounds have not been excavated but their shape and size would indicate that they were burial mounds.

(6.) The outworks, or groups of mounds in the vicinity of the village are worthy of notice. There are mounds on land belonging to Mr. Rose, on section 25, one mile or more distant. These mounds are situated near the line of the bluff overlooking the valley of the river, just at the point where the stream and the marsh join. These mounds are nearly obliterated, and their design could not be ascertained. They were, however, so situated in relation to the river and marsh and land adjoining, as to give rise to the idea that they were used possibly for game drives. The effigies were in a wheat field and could not be identified. The out-works which most interested us were those situated on the edge of the same marsh or lake, three miles to the west. These have been described by Dr. Lapham;* he calls them the mounds at Crawfordsville, although there is no village there and never was. The peculiarity of these works is that they are

*See Lapham's Antiquities.

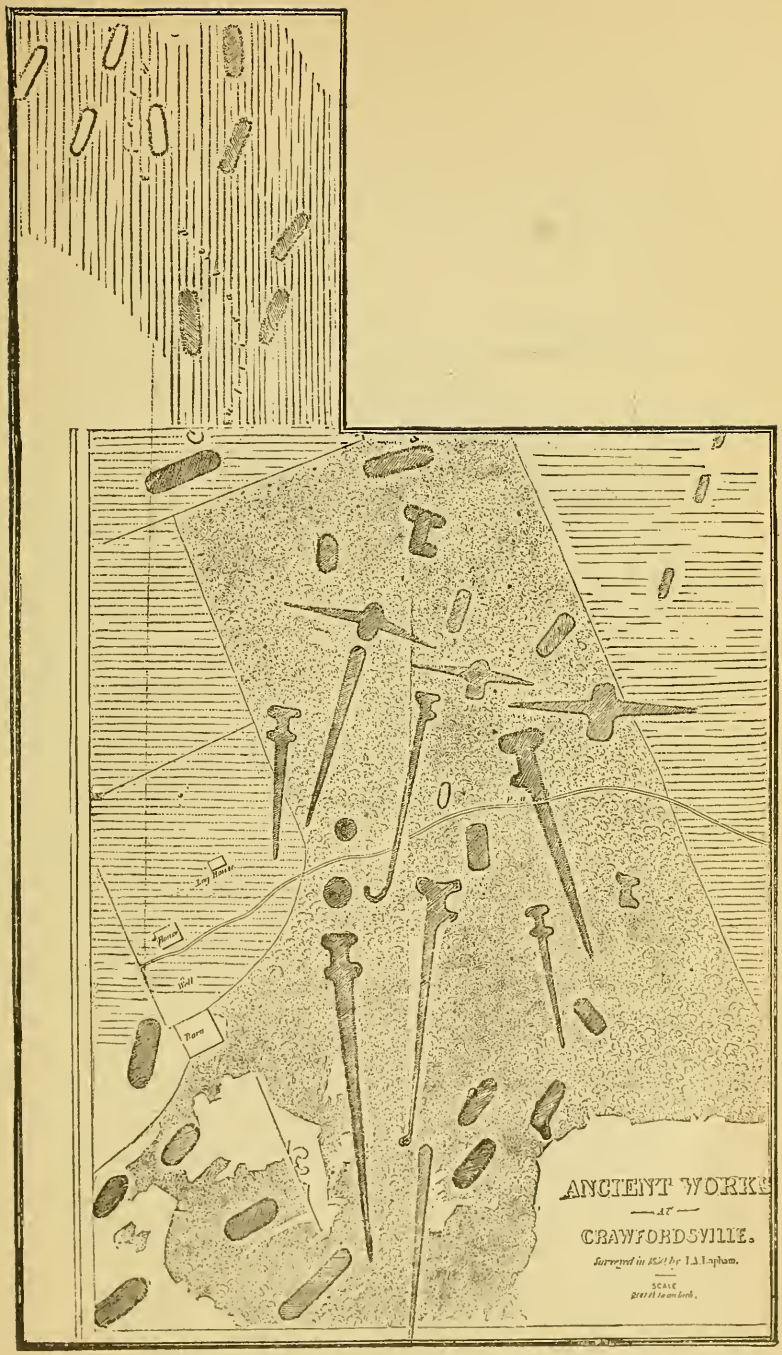

Fig. 4.—Effigies near Great Bend.

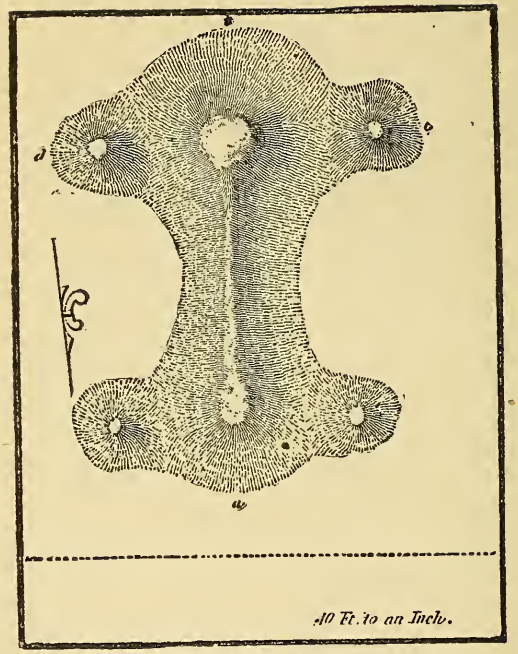

Fig. 5.—Altar Mound.

stretched along parallel with one another, and form a group resembling others which we have elsewhere identified as game drives. An illustration of the group is here given It will be noticed that the effigies are peculiarly situated and shaped; they are unnaturally prolonged, and so placed in reference to one another as to give the idea that they were intended as screens for hunters, and as traps for wild game. The arrangement of the ridges is not exactly in parallel lines, but at angles, each effigy serving to make a narrow place through which the animals would need to pass, and the oblong mounds forming guards to each opening, so that an additional opportunity for shooting the game might be furnished.

(7.) The most noticeable peculiarity of the region was the discovery of a so-called altar mound. We mention this last because it is the most suggestive and because it brings out the point of analogy between the village life of the mound builders and that of the Red Indians. There are no traditions connected with the locality but the religious significance of this group of works is apparent. On the summit of the hill overlooking the village itself is a small group of mounds, consisting of three oblong mounds and one effigy. The oblong mounds are situated on the brow of the bluff, and apparently were designed to serve as guards to the effigy. The effigy is what we have called an altar mound, as it has the same shape and situation with other mounds which have proved to contain altars, and is one which has been found in various particulars. The figures of it will illustrate the point. (See Fig. 5.) It is a mound formed by a combination of five mounds in one, the whole group making an effigy of an animal resembling the horned toad or frog. A ridge which connects two tumuli or conical mounds, forms the spine; four conical mounds situated at the corners formed the hips of the animals; the projections which represent legs are blunt and without particular resemblance to the animal formed. The distinguishing peculiarity of the effigy is that its form is an exact repetition of the shape of the bluff. The projections in the mounds imitate on a small scale the spurs on the side of the bluff itself, the two making a double effigy. As an additional feature

proving the religious character of the works, we may mention the existence of two massive burial mounds. These are situated on the low land below the bluff and between the bluff and the river. They are massive, and may have been the place where the bones of those who had been residents of the villages were borne after death and deposited. The altar mound was so situated that it could be seen from a great distance. If there were fires lighted on it they would gleam not only upon the waters and the river below, but they could be seen for miles away. There is no doubt that this was the place where sacrifices were offered and where religious ceremonies were observed. The group furnishes a most distinguishing peculiarity of village life.

One point additional which we have not mentioned is the line of communication of their villages in the same region. The trails which communicated between the villages of the Indians may prove an additional feature. These trails are known, and have been identified and traced by the author. The situation of the village on a well known route is at least worthy of study.

It was situated on the line of the dividing ridge, which has been used from time immemorial for a route from Lake Michigan to the Mississippi river. The route leads from Milwaukee through Muskegon lake, on through the Great Bend, crossing the Fox river; then at this point passes across the prairies to the west until it reaches the Rock river. Here it divides, one route turning south towards Beloit and Rockton and another towards Lake Koshkonong and the Four lake region where Madison now is. Passing from here the route crosses the dividing ridge between the Wisconsin river and the western branches of the Rock river, until it reaches the Blue Mounds. From the Blue Mounds it crosses prairies to the Platte Mounds and reaches the Mississippi river among the bluffs somewhere about Cassville. At each of these localities there are extensive works, showing that the same population and the same thoroughfares prevailed in prehistoric times which prevailed in the historic, the modern villages and cities having been placed on the very same sites where the ancient villages were.

The ancient trail was supplanted first by the stage route. The railroad has now taken the place of both. This village site has not been reached by the railroad although it was a favorite project to connect the interior with the lake by this route. The first plank road through the Milwauke mounds was built from Great Bend and Muskegon to Milwaukee. The first railroad struck the site of another native village, that at Waukesha and then passed on to the west. Proof furnished by the thoroughfares of modern days may not seem to be in point, and yet we take the ground that the natural advantages of the country have led to the choice of the same localities for residences, the same routes for travel, and the same spots for centers of population throughout the whole series of changes which have occurred both in historic and prehistoric times.

The proofs that this was a village site do not need to be dwelt upon longer. We only recapitulate the points which have been illustrated in this case that we may understand what are the characteristics of village life among the emblematic mound builders generally. We have 1st, the situation of villages as regards the means of subsistance, (a) on the edge of a forest and near a prairie abounding in wild game; (b) in proximity to wild rice swamps and near streams and forests where fruits and grains were abundant, (c.) it was near rivers and lakes where fish could be procured, and may have been a favorable position for the raising of maize and horticultural products. 2d. The character of the ground on which the village was located. (a.) It was isolated from the river and from the surrounding country. (b.) It was a favorable place for drainage and furnished favorable places for hiding their stores of grain.

3rd. Provisions for defense: (a) fragmentary walls placed on the edge of a hill; (b) effigies placed at the openings between; (c) a covered way, protecting the entrance to the village.

4th. The outworks accompanying the village consisting of (*a*) burial mounds; (*b*) game drives; (*c*) effigies protecting it; (*d*) look-out mounds in a prominent position; (*e*) other works designed to protect and to furnish means of subsistence.

5th. The evidences of religious observance: (a) the presence of the effigies surrounding the enclosure; (b) the number of burial mounds in the vicinity; (c) the altar and place of cremation.

6th. The situation of the works as related to the surrounding country: (a) its connection by streams and trails with other centres of population; (b) its location on a lake or river; (c) the character of the country surrounding as furnish opportunity of changing signals with distant points.

7th. The last characteristic and the chief is the presence of the enclosure. In this case the enclosure was marked, and affords undoubted evidence that a village was located here.

III. These evidences of village life have been dwelt upon, for they are essential in fixing the points where other villages were located. The comparison between this village of the emblematic mound-builders and the known villages of the later tribes have given us certain characteristics, but the comparison is hereafter to be between one village of the unknown people and other villages which may be presumably fixed upon. It is a method of gradual approach.

IV. We proceed, now, to consider other village sites, and to compare these with the one which has been identified. The second locality where an ancient village has been identified is at Waukesha. The points of .resemblance between the two localities are as follows:

1st. The locality was favorable for the subsistence of a large population. The same forests which intervene between the Fox river and the lake stretch northward, and here forms a border line between wood land and prairie, and between one form of natural products and another, thus affording a double supply of wild game and of nature's cereals and fruits. The locality is similar to that at Great Bend, in that there was an extensive prairie bordering upon an extensive marsh, and similar surroundings of high hills, and the same variety of soil. At this place there were formerly extensive groups of emblematic mounds, some of them on the prairie itself and some of them in the openings surrounding, and some on the summit of hills in the vicinity. It is evident from the na-

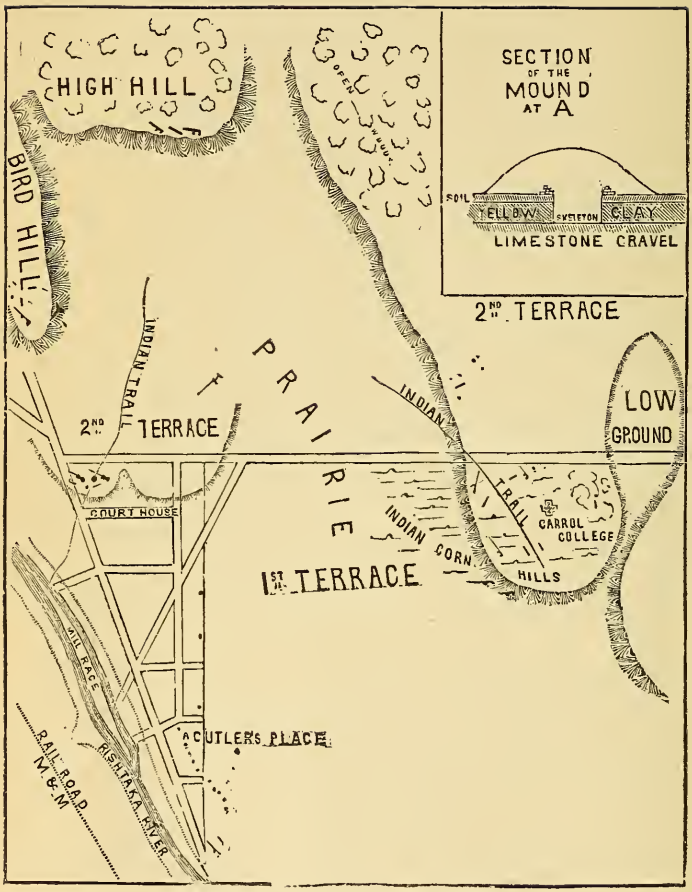

Fig. 6.—Map of Works at Waukesha.

ture of the works that here had been a center of native population. See map, Fig. 5.

The Fox river, also here furnishes a similar expanse of marsh filled with wild oats. The advantages for gaining a subsistence from the forests, and the stream and the open prairie are similar to these found in the previous locality. There are signs here of cultivation of the soil. (See Fig. 6.) We quote from Dr. Lapham: "Much of the ground about Waukesha was, in 1836, covered with Indian corn hills or remains of the recent culture of maize. In this locality as in numerous others, the mounds occupy the highest ground and the points of hills and other places whence the most extensive view, both above and below can be obtained. The town of Waukesha stands on a slightly undulating plain surrounded by hills, forming a fine amphitheatre, which in ancient times was doubtless crowded, as it is now, with numerous population. One fact is important in this connection —the mound builders occupied the same localities that are now the favorite resort of the present Indians, who still often make use of the mounds for the burial of their dead. They have a kind of veneration for them which may be the result of a lingering tradition. We need not look to Mexico nor any other country for the descendants of the mound builders. We probably see them in the present red race in the adjacent regions. Different tribes have different habits, and a stronger one may have overrun and swallowed up a weaker and then changed its customs and destroyed its institutions.

The corn hills found in this vicinity if they do not prove that the mound builders were agriculturists, or that here was an ancient village of the mound builders, at least they show the advantages of the locality. There are caches near Waukesha. A gentleman, long resident of the country, who owns a farm one mile east of the city, has pointed out a number of these caches on his land. They are like those at Great Bend, situated on the edge of a marsh and hidden away among deep forests. There are no effigies guarding these caches, and so we cannot ascribe them to the people who built the emblematic mounds. The coincidence, how-

ever, is worthy of thought for caches and corn fields indicate village residence.

2nd. The situation of the village with relation to lookouts and means of defense is worthy of notice. The reader will examine the map and compare it with the map at Great Bend and notice the occupied points in both. There are near the village high bluffs as at Great Bend. On these bluffs there are also emblematic mounds, which possibly were used as lookouts. Two of these groups overlook the village site; one which is not seen on the map is situated 1½ miles north of Waukesha. Dr. Lapham has described this group and a diagram is taken from his work. He says: "On a high and very commanding position" are three round mounds in front of four "lizard mounds." They are at the crossing of the old Madison road in the southwest quarter of Sec. 26 A. A sentinel stationed on them could give warning to the inhabitants on the approach of any hostile force long before they could reach the village. The lizards as in most other cases have their heads toward the south. "The general situation, distribution of the mounds as well as the topographical features of the country will be represented in the map." It will be noticed that they occupy three levels, those in the lower part mostly conical (probably Indian burial places those on the upper are on what may be called the second bank, others are on the high land east and south of the village.

We have referred to the turtle mound as forming a lookout. One of the most remarkable specimens of the turtle was found by Dr. Lapham at this place. The location of this would indicate that it was designed as a lookout to protect the village from approach by way of the river. The high bluff, called bird hill, is situated about one mile east of this. A description of this bird hill and its effigies has been given and does not need to be repeated. The village site was upon the grounds of Carroll College.

3rd. The form of the enclosure and the character of the ground are very similar to those found at Great Bend. Dr. Lapham says, the mounds form a quasi enclosure, and hence like many other groups of works, has been, by casual ob-

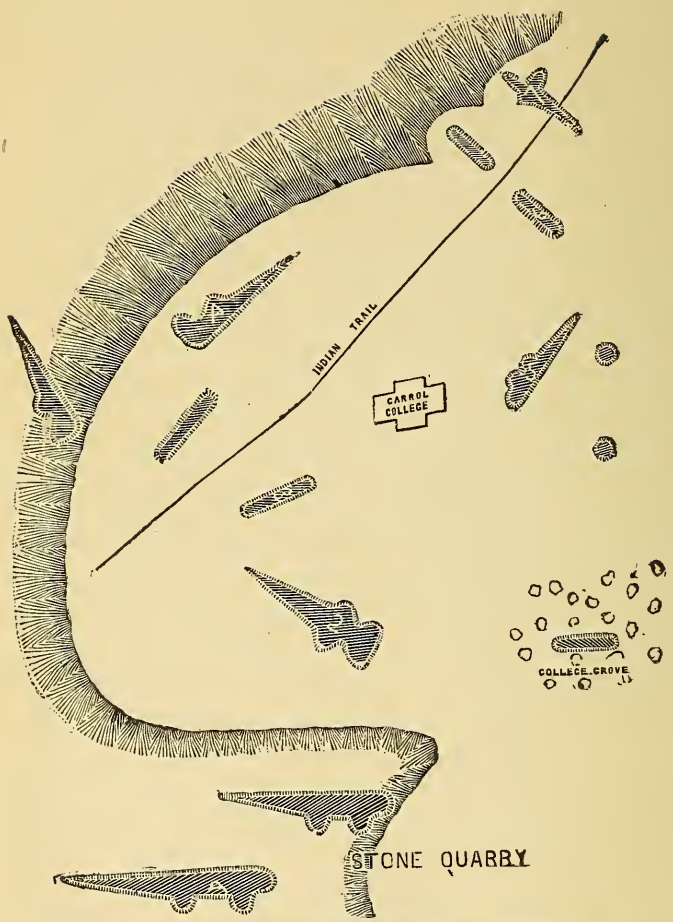

Fig. 7.--Ancient Village on College Campus at Waukesha.

servers, called a fort. If we were not well acquainted with the works in Ohio and elsewhere, which show that the mound builders were considerably advanced in military arts, we might suppose that this was intended for a rude fortification, but we can only regard it as an accidental arrangement, and not designed for any such purpose. Dr. Lapham's first impression of this locality was, however, a correct one. The mound builders' works were not all alike, and the system of defense which existed in Ohio would not be very likely to have appeared in Wisconsin. The emblematic mound builders defended their villages in a way peculiar to themselves. These fragmentary walls surrounding an enclosure were the means of defense by which the people guarded their villages. The ground on which the village is located is surrounded by low land, the same as that at Great Bend. The oblong mounds are erected near the edge of the rise of ground, and form a broken wall around the whole, making four sides of an enclosure, instead of three, as was the case in the former village. (See Fig. 7.)

4th. The effigies are quite similar. There are panther and wolf effigies both on the summit of the hill and upon its side. The effigies form a guard or defense to the enclosure and fill in the spaces between the oblong mounds. There is also a similar arrangement of parallel mounds which may be considered as forming the village, resembling that at Great Bend, but farther removed from the circumvallation and not so distinctly marked as a covered way. Still the analogy is worthy of notice.

5th. The covered way is another indication of a village site. There are or may be vilage sites which do not have this, but the parallel walls which lead to an enclosure may be generally regarded as an evidence that a village site has been reached. This is true, both among the emblematic mounds of Wisconsin and the earth-works of Ohio. Whether any such covered way can be found in other localities, it is true that in these two states it is peculiar to village sites. Marietta and Newark, Great Bend and Waukesha, may be compared, as the same feature is common to all.

6th. The outworks are similar to those a Great Bend. The hunting grounds which belong to this village are not found nearer than Pewaukee, which is about six miles away. There are works, there, however, which have been described by Dr. Lapham, and which have considerable resemblance to the works at Crawfordsville.

Another game drive has been discovered by the author on the very edge of Pewaukee lake. Here the mounds, which are all oblong mounds, are arranged in a peculiar position, making angles and open places along the brow of a bluff, as if the purpose was to make screens for hunters and traps for game. Whether these two series of works can be connected with the village site at Waukesha is a question, but we refer to them as among the items which make up the comparison between the villages.

V. Another locality where a village has been presumably identified is at Muscoda. The peculiarity here is that the enclosure was hidden away from observation by surrounding hill-tops, and was so remote from the river as to be entirely out of sight of any one who might be passing along the river. The enclosure is in a valley or swale, and has a number of effigies surrounding it. The effigies are all of them eagles. This village site has a number of game drives in proximity to it; two of them are situated on the same stream, only a mile or two away. The position of the enclosure is peculiar. The effigies and the fragmentary walls surround a swale, the land enclosed being much lower than that on which the effigies are placed. There are look-outs on a hill top three miles away, and there are nine wards or walls of defense in two separate lines between this place and the river. The spot is drained by waters of two small streams which make their head near this enclosure, Indian creek and Mill creek. The region is a favorable one for a village site. There are several particulars in which this enclosure resembles a village site.

MIGRATION AND DISTRIBUTION OF NORTH AMERICAN BIRDS IN BROWN AND OUTAGAMIE COUNTIES.

By S. W. Willard, West De Pere, Wis. (1883.)

This paper was prepared from recorded observations. It gives a systematic series of facts from which the generalizations of Messrs. Baird and Allen may be again applied.*

Brown County is well adapted for such a system of observation. The warm, short summers succeeded by the long cold winters mark distinctly each movement. The vernal and autumnal movements through these counties are large, thousands of migrants of species that are to some extent summer residents, pass us on their way to less crowded areas. These with the other migrants swell the throng to numbers almost incalculable.

To facilitate this study I have arranged the species in divisions based upon their migratory habits while in these counties.

Class I. Birds that are represented in this section throughout the year, but whose numbers vary in the different seasons. Members of this class may properly be called "residents."

†1. Parus atricapillus, L.
Black capped chickadee.

2. Sitta carolinensis, Gm.
White bellied nuthatch.

3. Cyanocitta cristata, (L.) Strickl.
Blue jay.

4. Picus villsus, L.
Hairy woodpecker.

5. Picus pubescens, L.
Downy woodpecker.

*Amer. Journal Sci. 1866, pp. 78, 184, 227 (Baird.) Scribner's Monthly 1881, pp. 932 (Allen.)

†Nomenclature from Coues' "Check list of N. A. Birds."

6. Bubo virginianus, (Gm.) Bp.
   Horned owl.
7. Scops asio, (L.) Bp.
   Screech owl.
8. Strix nebulosa, Forst.
   Barred owl.
9. Cupidonia cupido, (L.) Bd.
   Prairie hen.
10. Bonasa umbella, (L) Steph.
    Ruffled grouse.
11. Passer domesticus, (L.) Koch.
    English sparrow.

    (Although not a native of America, yet its increasing numbers and familiar habits bring it so prominently into view that to omit it would be unfair.)

Class II. Includes the true migrants or those birds in which the migratory instinct is so strong as to urge onward their movements regardless of weather or the food supply.

1. Turdus migratorius, L.
   Robin. (Breeds.)
2. Turdus fuscescens, Steph.
   Wilson's thrush.
3. Turdus unalascæ nanus, (Aud.) Coues.
   Hermit thrush.
4. Turdus ustulatus aliciæ, (Bd.) Coues.
   Alice's thrush.
5. Turdus ustulatus swainsoni, (Cab.) Coues.
   Olive backed thrush.
6. Mimus carolinensis, (L.) Gr.
   Cat bird. (Breeds.)
7. Harporhynchus rufus, (L.) Cab.
   Brown thrush. (Breeds.)
8. Sialia sialis, (L.) Hald.
   Blue bird. (Breeds.)
9. Regulus calendula, (L.) Licht.
   Ruby crowned kinglet.
10. Regulus satrapa, Licht.
    Golden crowned kinglet.

11. Troglodytes domesticus, (Bartr.) Coues.
House wren. (Breeds.)

12. Telmatodytes palustris, (Bartr.) Cab.
Long billed marsh wren. (Breeds.)

13. Cistothorus stellaris, (Licht.) Cab.
Short billed marsh wren. (Breeds in Outagamie Co.)

14. Anthus ludovicianus, (Gm.) Licht.
Titlark.

15. Mniotilta varia, (L.) V.
Black and white creeper. (Breeds.)

16. Parula americana, (L.) Bp.
Blue yellow-backed warbler. (Breeds.)

17. Helminthophaga chrysoptera, (L.) Bd.
Blue golden winged warbler. (Breeds.)

18. Helminthophaga ruficapilla, (Wils.) Bd.
Nashville warbler.

19. Helminthophaga celata, (Say) Bd.
Orange crowned warbler.

20. Helminthophaga peregrina, (Wils.) Cab.
Tennessee warbler.

21. Dendrœca aestiva, (Gm.) Bd.
Summer warbler. (Breeds.)

22. Dendrœca virens, (Gm.) Bd.
Black throated green warbler.

23. Dendrœca cærulescens, (L.) Bd.
Black throated blue warbler.

24. Dendrœca coronata, (L.) Gr.
Yellow rumped warbler.

25. Dendrœca blackburniæ, (Gm.) Bd.
Blackburn's warbler.

26. Dendrœca striata, (Forst) Bd.
Black poll warbler.

27. Dendrœca castanea, (Wils.) Bd.
Autumnal warbler.

28. Dendrœca pennsylvanica, (L.) Bd.
Chestnut sided warbler. (Breeds.)

29. Dendrœca maculosa, (Gm.) Bd.
Black and yellow warbler.

30. Dendrœca tigrina, (Gm.) Bd.
Cape May warbler.

31. Dendrœca palmarum, (Gm.) Bd.
Yellow red poll warbler.

32. Dendrœca pinus, (Bartr.) Bd.
Pine creeping warbler.

33. Siurus auricapillus, (L.) Sw.
Golden crowned thrush. (Breeds.)

34. Siurus nævius, (Bodd.) Coues.
Water thrush. (Breeds.)

35. Geothlypis trichas, (L.) Cab.
Maryland yellow throat. (Breeds.)

36. Myiodioctes pusillus, (Wils.) Bp.
Green black capped warbler.

37. Myiodioctes canadensis, (L.) Aud.
Canadian fly catching warbler.

38. Setophaga ruticilla, (L.) Sw.
American redstart. (Breeds.)

39. Pyranga rubra, (L.) V.
Scarlet tanager. (Breeds.)

40. Hirundo erythrogastra horreorum, (Bartr.) Coues.
Barn swallow. (Breeds.)

41. Iridoprocne bicolor, (V.) Coues.
White bellied swallow. (Breeds.)

42. Petrochelidon lunifrons, (Say) Cab.
Eave swallow. (Breeds.)

43. Cotile riparia, (L.) Boie.
Bank swallow. (Breeds.)

44. Stelgidopteryx serripennis, (Aud) Bd.
Rough winged swallow. (Breeds Outagamie Co.)

45. Progne subis, (L.) Bd.
Purple marten. (Breeds.)

46. Ampelis cedrorum, (V.) Bd.
Cedar bird. (Breeds.)

47. Vireo olivaceus, (L.) V.
Red eyed greenlet. (Breeds.)

48. Viveo philadelphicus, Cass.
Brotherly love vireo.

49. Vireo gilvus, (V.) Bp.
Warbling vireo. (Breeds.)

50. Vireo flavifrons, V.
Yellow throated vireo. (Breeds Outagamie Co.)

51. Vireo solitarius, V.
Blue headed vireo.

52. Lanius ludovicianus excubitorides, (Sw.) Coues.
White rumped shrike. (Breeds.)

53. Passerculus sandvicensis savanna, (Wils.) Ridg.
Savanna sparrow. (Breeds.)

54. Pocecetes gramineus, (Gm.) Bd.
Grass finch. (Breeds.)

55. Melospiza lincolni, (Aud.) Bd.
Lincoln's song sparrow.

56. Melospiza palustris (Bartr.) Bd.
Swamp song sparrow. (Breeds).

57. Melospiza fasciata, (Gm.) Scott.
Song sparrow. (Breeds.)

58. Spizella domestica, (Bartr.) Coues.
Chipping sparrow. (Breeds.)

59. Zonotrichia albicollis, (Gm.) Bp.
White-throated sparrow. (Breeds Outagamie Co.)

60. Zonotrichia leucophrys, (Forst.) Sw.
White-browed sparrow.

61. Chondestes grammicus, (Say) Bp.
Lark finch. (Breeds.)

62. Passerella iliaca, (Merr.) Sw.
Fox colored sparrow.

63. Zamelodia ludoviciana, (L.) Coues.
Rose breasted grosbeak. (Breeds.)

64. Passerina cyanea, (L.) Gray.
Indigo bird. (Breeds.)

65. Pipilo erythrophthalmus, (L.) V.
Chewink. (Breeds.)

66. Dolichonyx oryzivorus, (L.) Sw.
Bobolink. (Breeds.)

67. Molothrus ater, (Bodd.) Gray.
Cow bird. (Breeds.)

68. Xanthocephalus icterocephalus, (Bp.) Bd.
Yellow headed blackbird.

69. Sturnella magna, (L.) Sw.
Meadow lark. (Breeds.)

70. Icterus galbula, (L.) Coues.
Baltimore oriole. (Breeds.)

71. Quiscalus purpureus, (Bartr.) Licht.
Purple grackle. (Breeds.)

72. Tyrannus carolinensis, (L.) Bd.
King bird. (Breeds.)

73. Myiarchus crinitus, (L.) Cab.
Great crested fly-catcher. (Breeds Outagamie Co.

74. Sayiornis fusca, (Gm.) Bd.
Phoebe. (Breeds.)

75. Contopus virens, (L.) Cab.
Wood pewee. (Breeds.)

76. Empidonax minimus, Bd.
Least fly-catcher. (Breeds.)

77. Empidonax flaviventris, Bd.
Yellow bellied fly-catcher.

78. Antrostomus vociferus, (Wils.) Bp.
Whip-poor-will. (Breeds.)

79. Chordediles popetue, (V.) Bd.
Night hawk. (Breeds.)

80. Chætura pelasgica, (L.) Steph.
Swift. (Breeds.)

81. Trochilus colubris, L.
Ruby throated hummer. (Breeds.)

82. Ceryle alcyon, (L.) Boie.
Kingfisher. (Breeds.)

83. Coccygus erythrophthalmus, (Wils.) Bd.
Black billed cuckoo. (Breeds.)

84. Coccygus americanus, (L.) Bp.
Yellow billed cuckoo. (Breeds.)

85. Sphyropicus varius, (L.) Bd.
Yellow bellied woodpecker. (Breeds.)

86. Melanerpes erythrocephalus, (L.) Sw.
Red headed woodpecker. (Breeds.)

87. Colaptes auratus, (L.) Sw.
Flicker. (Breeds.)

88. Asio wilsonianus, (Less.) Coues.
Long eared owl. (Breeds.)

89. Asio accipitrinus, (Pall.) Newt.
Short eared owl.

90. Circus cyaneus hudsonius, (L.) Coues.
Marsh hawk. (Breeds.)

91. Accipiter fuscus, (Gm.) Bp.
Pigeon hawk.

92. Accipiter cooperi, Bp.
Cooper's hawk. (Breeds.)

93. Falco columbarius, L.
Pigeon falcon.

94. Falco sparverius, L.
Sparrow hawk.

95. Buteo borealis, (Gm.) V.
Hen hawk.

96. Ectopistes migratorius, (L.) Sw.
Wild pigeon. (Breeds.)

97. Zenaidura carolinensis, (L.) Bp.
Carolina dove. (Breeds.)

98. Squatarola helvetica, (L.) Cuv.
Black bellied plover.

99. Charadrius dominicus, Müll.
Golden plover.

100. Ægialites vociferus, (L.) Cass.
Kildeer plover. (Breeds.)

101. Ægialites semipalmatus, (Bp) Cab.
Ring neck plover.

102. Lobipes hyperboreus, (L.) Cuv.
Northern phalarope.

103. Philohela minor, (Gm) Gr.
Woodcock. (Breeds.)

104. Gallinago wilsoni, (Temm.) Bp.
Wilson's snipe. (Breeds.)

105. Ereunetes pusillus, (L.) Cass.
Semipalmated sandpiper.

106. Actodromas minutilla, (V.) Coues.
Least sandpiper.

107. Actodromas bairdi, Coues.
Baird's sandpiper.

108. Actodromas maculata, (V.) Coues.
Jack snipe.

109. Pelidna alpina americana, (Cass.) Allen.
Dunlin.

110. Symphemia semipalmata, (Gm.) Hartl.
Willet.

111. Totanus melanoleucus, (Gm.) V.
Greater tattler.

112. Totanus flavipes, (Gm.) V.
Lesser tattler.

113. Rhyacophilus solitarius, (Wils.) Bp.
Solitary tattler. (Breeds Outagamie Co.)

114. Tringoides macularius. (L.) Gr.
Spotted sandpiper. (Breeds.)

115. Tryngites rufescens, (V.) Cab.
Buff breasted sandpiper.

116. Ardea herodias, L.
Great blue heron. (Breeds.)

117. Botaurus mugitans. (Bartr.) Coues.
Bittern. (Breeds.)

118. Rallus virginianus, L.
Virginia rail. (Breeds Outagamie Co.)

119. Porzana carolina, (L.) V.
Common rail. (Breeds.)

120. Anas boscas, L.
Mallard. (Breeds.)

121. Anas obscura, Gm.
Black mallard.

122. Dafila acuta, (L.) Jen.
Pintail. (Breeds Outagamie Co.)

123. Chaulelasmus streperus, (L.) Gr.
Gadwall.

124. Mareca americana, (Gm.) Steph.
Widgeon.

125. Querquedula carolinensis, (Gm.) Steph.
Green winged teal.

126. Querquedula discors, (L.) Steph.
Blue winged teal. (Breeds.)

127. Spatula clypeata, (L.) Boie.
Shoveler.

128. Aix sponsa, (L.) Boie.
Wood duck. (Breeds.)

129. Mergus merganser, L.
Merganser or fish duck.

130. Mergus serrator, L.
Red breasted merganser.

131. Mergus cucullatus, L.
Hooded merganser. (Breeds.)

132. Sterna hirundo, L.
Common tern.

133. Hydrochelidon lariformis, (L.) Coues.
Black tern.

134. Podicipes cornutus, (Gm.) Lath.
Horned grebe.

135. Podilymbus podiceps, (L.) Lawr.
Hell diver.

Class III: Birds that are migratory but whose movements through these counties seem greatly influenced by changes of temperature. A moderate variation in our winter would undoubtedly cause many individuals of these species to become "winter residents" in this locality.

1. Certhia familiaris, L.
Brown creeper. (Breeds.)
2. Sitta canadensis, L.
Red bellied nuthatch.
3. Eremophila alpestris, (L.) Boie. (var. praticola, Henshaw, 1884)
Horned lark. (Breeds.)
4. Lanius borealis, V.
Butcher bird.
5. Carpodacus purpureus, (Gm.) Gr.
Purple finch. (Breeds.)
6. Astragalinus tristis, (L.) Cab.
Yellow bird. (Breeds.)
7. Junco hiemalis, (L.) Scl.
Snow bird.
8. Spizella monticola, (Gm.) Bd.
Tree sparrow.
9. Agelæus phœniceus, (L.) V.
Red winged blackbird. (Breeds.)
10. Scolecophagus ferrugineus, (Gm.) Sw.
Rusty grackle.
11. Corvus frugivorus, Bartr.
Crow. (Breeds.)

12. Astur atricapillus, (Wils.) Bp.
Goshawk.

13. Archibuteo lagopus sancti-johannis, (Gm.) Ridg.
Rough-legged buzzard.

Class IV. Birds that are migratory, but whose movements, with those of Class III., are influenced to a great extent by immediate changes of temperature. In this class the southward movement is deterred until the freezing of our bays and rivers. Pot hunters for many seasons past have taken most of the following species, up to the very day of freezing up :

1. Fulica americana, Gm.
Coot

2. Chen hyperboreus, (Pall.) Boie.
Snow goose.

3. Bernicla canadensis, (L.) Boie.
Canada goose.

4. Haliaetus leucocephalus, (L.) Savig.
Bald eagle. (Breeds).

5. Bernicla canadensis hutchinsi, (Rich.) Coues.
Hutchin's goose.

6. Fuligula marila, (L.) Steph.
Greater black head.

7. Fuligula affinis, Eyt.
Lesser black head.

8. Fuligula collaris, (Donov.) Bp.
Ring neck duck. (Breeds Outagamie Co.)

9. Fuligula ferina americana, (Eyt.) Coues.
Red head.

10. Fuligula vallisneria, (Wils.) Steph.
Canvas back.

11. Clangula glaucium, (L.) Brehm.
Golden eye. (Breeds Outagamie Co.)

12. Clangula albeola, (L.) Steph.
Buffle head.

13. Harelda glacialis, (L.) Leach.
Long tailed duck.

14. Œdemia americana, Sw.
Black scoter.

15. Œdemia fusca, (L.) Flem.
Velvet scoter.

16. Erismatura rubida, (Wils.) Bp.
Ruddy duck.

17. Larus argentatus, Brünn.
Herring gull.

18. Larus delawarensis, Ord.
Ring billed gull.

19. Chroicocephalus philadelphia, (Ord.) Lawr.
Bonaparte's gull.

20. Colymbus torquatus. Brünn.
Loon.

Class V. — Birds from northern sections that visit us each fall. Some of the species remaining throughout the winter, others appearing irregularly during the colder months.

1. Anorthura troglodytes hiemalis, (Wils.). Coues.
Winter wren. (A few breed in Outagamie Co.)

2. Ampelis garrulus, L.
Bohemian waxwing.

3. Pinicola enucleator, (L.) V.
Pine grosbeak.

4. Loxia leucoptera, Gm.
Whi e winged crossbill.

5. Loxia curvirostra americana (Wils.) Coues.
Common crossbill,

6. Ægiothus linaria, (L.) Cab.
Red-poll linnet.

7, Chrysomitris pinus, (Bartr.) Bp.
Pine linnet.

8. Plectrophanes nivalis, (L.) Meyer.
Snow bunting.

9. Centrophanes lapponicus, (L.) Kaup.
Lapland longspur.

10. Perisoreus canadensis, (L.) Bp.
Canada jay.

11. Picoides arcticus, (Sm.) Gray.
Black backed three-toed woodpecker.

12. Nyctea scandiaca, (L.) Newt.
Snowy owl.

13. Nyctala acadica, (Gm.) Bp.
Saw whet owl. (Breeds.)

CLASS VI. Birds whose visitations are so rare as to compel me to place them in my list either as a stray from other sections, or as one whose regular occurrences have escaped my notice.

1. Turdus mustelinus, Gm.
Wood thrush.
I have found but one pair of these birds in Brown county, and they were nesting; the nest contained three eggs.

2. Protonotaria citrea, (Gm.) Bd.
Prothonotary warbler.
A single specimen was taken May 4, 1883, by Mr. F. L. Grundtvig, at Shiocton.

3. Spizella agrestis, (Bartr.) Coues.
Field sparrow.
A southerly bird, taken in Brown Co. only a few times in 1882.

4. Junco hiemalis oregonus, (Towns.) Coues.
Oregon snow bird.
A specimen of Junco was taken in W. De Pere October 6th, 1883, the markings (identified by Coues) inclined strongly towards oregonus

5. Icterus spurius, (L.) Bp.
Orchard oriole.
Noticed but twice in Brown Co.

6. Hylotomus pileatus, (L.) Bd.
Pileated woodpecker.
Heavier timber seems to be all that is necessary to make this species a resident in Brown Co.

7. Pandion haliaetus, (L.) Sav.
Fish hawk.
Only occasionally seen in Brown Co.

8. Corvus corax, L.
Raven.
I have taken but one specimen in Brown Co.

9. Centurus carolinus, (L.) Bp.
   Red bellied woodpecker.
   A rare spring visitor.

10. Cathartes aura, (L.) Ill.
    Turkey buzzard.
    None seen in Brown Co., a few were noticed by Mr. F. L. Grundtvig in Outagamie Co.

11. Ortyx virginiana, (L.) Bp.
    Quail.
    I have not met this species in Brown Co., although Louis Sheller, Green Bay, has a mounted specimen which he claims to have taken here.

12. Strepsilas interpres, (L.) Ill.
    Turnstone.
    June 2, '82, a flock of 5 of these birds were seen near West De Pere, 3 were taken.

13. Limosa fœda, (L.) Ord.
    Marbled godwit.
    Louis Scheller reports having taken this species near Green Bay I have not found it.

14. Bartramia longicauda, (Bechst.) Coues.
    Field plover.
    May 1st '82, a single specimen was taken by Harry Hammond in West De Pere.

15. Butorides virescens, (L.) Cab.
    Green heron.
    Mr. F. L. Grundtvig saw a single specimen near Shiocton, Outagamie Co.

16. Ardetta exilis, (Gm.) Gr.
    Least bittern.
    May 20th '83, a male of this species was taken near West De Pere.

17. Gallinula galeata, (Licht.) Bp.
    Florida gallinule.
    Subsequent observation (1884) warrants the insertion of this species in Class II.

18. Chen hyperboreus albatus, (Cass.) Ridg.
    Lesser snow goose.
    April 22d '81, a single specimen was taken on the shore of Fox River near De Pere.

Summing up the above six classes, I find the avian fauna of Brown and Outagamie counties, to consist of two-hundred

and ten species. Eleven are residents throughout the year. Eighteen are strays or very rare visitors. Eighty-seven are summer residents, and ninety-four are through migrants. Of the above residents and migrants, one-hundred species have been known to breed in either Brown or Outagamie counties.

In the following table, I have attempted to compare the arrival of our migratory birds, for the years 1882 and 1883; giving as data, the results of Mr. F. L. Grundtvigs's observations at Shiocton, and mine at West De Pere.

Great value should especially be placed upon the observations of Mr. F. L. Grundtvig, while at Shiocton, for during these observations, his whole time was constantly devoted to the work. The collecting trips, usually made twice each day, took him through varied places, on both land and water.

Each arrival was recorded after personal observation and careful study. Few species escaped his notice, and no arrival to my knowledge, was omitted from his daily record.

Care should be exercised in using my notes with his. Although I have been very careful to record each arrival, and note every fact of interst respecting our birds, yet, owing to the many hurried trips that I was obliged to take, arrivals of the more shy and retiring species unquestionably escaped my notice, until increasing numbers made them more conspicuous. At times, a day or so would pass without the customary tramp; but afterwards, I was slow to record any species, whose abundance indicated that they had arrived during my absence. This partly explains a number of the instances where "A" in the following table has been placed among the Brown County arrivals.

ARRIVAL OF MIGRANTS IN BROWN AND OUTAGAMIE COUNTIES CONSECUTIVELY COMPARED FOR THE YEARS 1882 AND 1883.

	First Arrivals, Outagamie Co., 1882.	First Arrivals, Brown Co., 1882.	First Arrivals, Outagamie Co., 1883.	First Arrivals, Brown Co., 1883.
Turdus migratorius	Feb. 26	Mar. 10	Mar. 22	Mar. 26
Turdus fuscescens	May 10	May 8	May 22	A.*
Turdus unalascæ nanus	April 10	April 22	April 22	April 5
Turdus ustulatus swainsoni	May 10	B†	B.	B.
Mimus carolinensis	May 9	May 14	May 8	May 14
Harporhynchus rufus	May 7	May 18	B.	April 11
Sialia sialis	Mar. 3	Mar. 14	Mar. 29	Mar. 29
Regulus calendula	April 10	April 14	April 11	April 10
Regulus satrapa	April 9	April 3	April 9	April 5
Certhia familiaris	Mar. 28	April 6	Mar. 20	April 9
Troglodytes domesticus	May 5	May 13	May 7	May 12
Telmatodytes palustris	May 30	A.	A.	B.
Cistothorus stellaris	May 18	B.	A.	B.
Anthus ludovicianus	May 20	B.	B.	B.
Mniotilta varia	May 1	May 10	May 6	May 14
Parula americana	May 3	A.	May 7	May 23
Helminthophaga chrysoptera	May 15	May 10	May 19	May 15
Helminthophaga ruficapilla	May 4	May 8	May 7	B.
Helminthophaga celata	April 30	B.	May 1	B.
Helminthophaga peregrina	May 19	A.	May 22	May 21
Dendroeca aestiva	May 3	May 10	May 7	A.
Dendrœca virens	May 4	May 10	May 7	A.
Dendrœca caerulescens	May 8	B.	May 12	May 15
Dendrœca coronata	April 5	April 6	April 12	April 9
Dendrœca blackburniae	May 3	May 10	May 7	May 15
Dendrœca striata	May 10	A.	May 18	May 19
Dendrœca castanea	May 18	May 8	May 20	A.
Dendrœca pennsylvanica	May 3	May 10	May 8	A.
Dendrœca maculosa	May 3	A.	May 14	A.
Dendrœca tigrina	May 8	May 9	May 7	May 15
Dendrœca palmarum	May 1	A.	May 7	B.
Dendrœca pinus	May 3	April 21	April 24	May 15
Siurus auricapillus	May 9	May 8	May 9	May 15
Siurus naevius	April 26	A.	April 30	A.
Geothlypis trichas	May 10	May 31	May 10	A.
Myiodioctes pusillus	May 12	May 18	May 18	May 31
Myiodioctes canadensis	May 10	A.	May 18	B.
Setophaga ruticilla	May 3	May 10	May 7	May 15
Pyranga rubra	May 10	May 18	May 22	May 20
Hirundo erythrogastra horreorum	April 29	May 15	May 7	May 10
Iridoprocne bicolor	Mar. 29	April 1	April 7	May 7

* "A." Through neglect or omission the dates of the first arrivals were not recorded.
† "B." This species not noticed in the spring of that year.

ARRIVAL OF MIGRANTS IN BROWN AND OUTAGAMIE COUNTIES, ETC.—Continued.

	First arrivals, Outagamie Co., 1882.	First arrivals, Brown Co., 1882.	First arrivals, Outagamie Co., 1883.	First arrivals, Brown Co., 1883.
Petrochelidon lunifrons	April 25	April 21	April 29	May 10
Cotile riparia	May 12	B.	B.	B.
Stelgidopteryx serripennis	April 24	May 14	A.	May 21
Progne subis	April 10	April 16	A.	A.
Ampelis cedrorum	May 19	June 5	A.	A.
Vireo olivaceus	May 11	May 22	May 18	May 26
Vireo philadelphicus	May 23	May 31	B.	B.
Vireo gilvus	May 9	A.	May 8	A.
Vireo flavifrons	May 8	May 26	May 5	May 14
Vireo solitarius	B.	May 18	May 7	B.
Lanius ludovicianus excubitorides	A.	A.	A.	April 8
Carpodacus purpureus	Mar. 5	April 14	April 9	Mar. 14
Passerculus sandvicensis savana	A.	A.	April 26	April 28
Pocœcetes gramineus	April 14	April 14	April 9	April 9
Melospiza lincolni	May 20	B.	B.	B.
Melospiza palustris	.....	.....	.....	.....
Melospiza fasciata	Mar. 29	Mar. 28	April 6	April 6
Spizella domestica	April 20	April 19	April 12	April 18
Zonotrichia albicollis	April 25	May 8	April 22	A.
Zonotricha leucophrys	May 13	A.	May 12	May 14
Chondestes grammicus	B.	May 3	B.	May 5
Passerella iliaca	April 13	April 21	April 9	April 11
Zamelodia ludoviciana	May 9	A.	May 16	May 23
Passerina cyanea	May 18	May 17	May 22	May 25
Pipilo erythrophthalmus	April 26	April 21	April 26	April 11
Dolichonyx oryzivorus	May 17	A.	May 15	May 15
Molothrus ater	April 17	April 14	May 3	April 11
Xanthocephalus icterocephalus	May 30	B.	B.	B.
Sturnella magna	Mar. 28	Mar. 28	April 2	April 6
Icterus galbula	May 4	May 5	May 7	May 13
Quiscalus purpureus	Mar. 29	April 3	April 6	April 8
Tyrannus carolinensis	May 8	April 12	May 7	May 14
Myiarchus crinitus	May 14	B.	May 7	B.
Sayornis fusca	April 2	Mar. 29	April 6	April 8
Contopus virens	May 20	A.	May 26	A.
Empidonax minimus	May 5	A.	May 7	May 10
Empidonax flaviventris	May 18	A.	May 22	B.
Antrostomus vociferus	April 28	A.	April 26	A.
Chordediles popetue	May 19	A.	May 1	A.
Chætura pelasgica	May 9	April 1	May 7	May 10
Trochilus colubris	May 9	May 20	May 17	A.
Ceryle alcyon	April 1	April 9	April 9	April 11
Coccygus erythrophthalmus	May 18	May 20	May 25	B.
Sphyropicus varius	Mar. 27	April 7	April 9	April 7
Melanerpes erythrocephalus	May 12	April 3	May 8	May 15
Colaptes auratus	April 1	April 3	April 9	April 12

Believing that there exists certain relations between the dietetic habits of our true migrants and their order of arrival, I have prepared the following annotated list. I have chosen the order in which they arrived in the spring of 1882, as my observations then were more thorough than in 1883:

Turdus migratorius. (Robin.) Mch. 10.
Its principal food consists of worms, caterpillars and berries.*

Sialia sialis. (Blue bird.) Mch. 14.
Food — Larvæ and insects.

Sturnella magna. (Meadow lark.) Mch. 28.
Food — Larvæ and insects.

Melospiza fasciata. (Song sparrow.) Mch. 28.
Food — Seeds and insects.

Sayiornis fusca. (Phœbe.) Mch. 29.
A purely insectivorous bird.

Iridoprocure bicolor. (White bellied swallow.) Apr. 1.
Also an insectivorous bird.

Quiscalus purpureus. (Purple grackle) Apr. 3.
In the spring its food is mostly worms, grubs and caterpillars.

Regulus satrapa. (Golden crowned kinglet.) Apr. 3.
Food — Small insects and larvæ.

Colaptes auratus. (Flicker.) Apr. 3.
Food — Ants, beetles and caterpillars.

Certhia familiaris. (Brown creeper.) Apr. 6.
Food — Small beetles and insects.

Dendrœca coronata. (Yellow rump warbler.) Apr. 6.
Food — Caterpillars, small flies and beetles.

Sphyropicus varius. (Yellow bellied wood-pecker.) Apr. 7.
Food — Ants, beetles and small insects.

Tyrannus carolinensis. (King bird.) Apr. 12.
Food is wholly insectivorous.

Regulus calendula. (Ruby crowned kinglet.) Apr. 14.
Food — Larvæ and small insects.

Carpodacus purpureus. (Purple finch.) Apr. 14.
Food — Seeds, buds, plant-lice and caterpillars.

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* The notes respecting the food were mostly taken from Prof. F. H. King's work, entitled "The Economic Relations of Wisconsin Birds," published in "Geology of Wisconsin," Vol. I.

Pocecetes gramineus. (Grass finch.) Apr. 14.
Food — Seeds and insects.

Molothrus ater. (Cow bird.) Apr. 14.
Food is chiefly insects.

Progne subis. (Purple marten.) Apr. 16.
Food wholly insectivorous.

Spizella domestica. (Chipping sparrow.) Apr. 19.
Food — Seeds, worms and insects.

Petrochelidon lunifrons. (Eave swallow.) Apr. 21.
Food wholly insectivorous.

Passerella iliaca. (Fox sparrow.) Apr. 21.
Food — Seeds, bugs and insects.

Pipilo erythrophthalmus. (Chewink.) Apr. 21,
Food — Seeds, insects and worms,

Turdus unalascæ nanus. (Hermit thrush.) Apr. 22.
Food — Ants, beetles and caterpillars.

The seed eaters as will be seen by this list, do not appear to arrive in force, until some time after the insect eaters have made their appearance. This is quite contrary to some existing ideas now held by some naturalists respecting these movements. But why these birds are not among the very first, appears to me a singular anomaly. In their case, the temperature must be an important agent in influencing their movements, for their food, the seeds, are as easily obtained in the earlier months, as in May or June, no new plants having had time to flower before their arrival.

While the food of a few of the earlier migrants consists chiefly of winged insects, yet the majority of the first comers subsist upon grubs, caterpillars and worms, that are largely found in crevices in the bark of trees, under fallen limbs, on old rails, and in many other similar places. Unless these birds are gifted with the art of discovering larvæ and insects while in their winter quarters, the awakening of articulate life must be an important factor in affecting these migrations.

Mr. F. L. Grundtvig when pursuing his close observations discovered that the yellow rumps (Dendrœca coronata) when they first arrived, associated more or less with the woodpeckers, and like them were successful in obtaining con-

cealed larvæ and small insects from under the edges of the shaggy bark. They were seen to frequent the terminal branches, and seek their food amidst the starting foliage, after the only throng of their brother warblers began to arrive and winge insects were becoming numerous.

This matter of being able to obtain sufficient insect food in various ways, must give this warbler an advantage over its allies, which I think may possibly account for its immense numbers as compared with some of the other species.

Does not this rule apply to other birds as well, and in part explain the reason why our earlier species are among our *most abundant* birds?

Birds in districts of homogeneous characters are restricted to certain areas by isotherms, but in country not entirely suitable for certain representative species, would not the isotherm be only a minor consideration as affecting their distribution ?

Can we properly judge of the extent of the faunal areas in any specified section, until the whole section is practically inhabitable for them during the warmer months ? In other words, as civilization progresses and timbered districts and swampy tracts become converted into meadows and farming lands, may not the avian fauna of an adjoining southern district extend northward until checked by the isotherm that constitutes the actual boundary of these divisions ? Brown County at the lower terminus of the Fox River Valley is the last of a series of counties connecting with the warmer sections of sonthern Wisconsin and northern Illinois, that are throughout habitable for such birds as prefer meadows and cultivated fields.

As single field sparrows, orchard orioles, and wood thrushes are found here only at irregular intervals, must we not feel confident of the close proximity of the northern limit of the Alleghanian fauna, of which they are representative members ?

Shiocton, Outagamie Co., the place of Mr. F. L. Grundtvig's diligent and thorough observations is almost directly west from us at De Pere, yet notwithstanding this, he has never on any of his varied excursions found the lark finch,

field sparrow or orchard oriole. Around Shiocton there are farms and some meadow lands but they are isolated. For miles on either side extends a tract of worthless land, once a forest, but now transformed by destructive fires into an impenetrable non-productive area. The banks of the Wolf River are at present wholly covered with green timber which is well adapted for arboreous species, but not for those referred to above. With these considerations in mind I believe that the northern limit of the Alleghanian fauna in eastern Wisconsin is not far from the southern boundary of Marinette County or where it meets the waters on the western shore of Green Bay.

THE VARIATION IN ATTRACTION DUE TO THE FIGURE OF THE ATTRACTING BODIES.

By D. P. Blackstone, A. M., C. E., Berlin, Wis.

INTRODUCTION.

1. This paper is a part of the investigations that I have nearly completed on the subject, *The Variation in Figure and in Attraction of a once Fluid Body, due to Rotation, Law of Density, and Contraction.* The portion of the investigations on that subject pertaining to attraction, herein given, is abbreviated by the omission of some of the mathematical demonstrations, and some evident deductions. The results attained by my method give numerical exactness to any power of the eccentricity of the ellipsoid.

This paper develops by geometrical methods the law of attraction for spheres, each of homogeneous mass, or each or either composed of fluid masses of heterogeneous densities. It also develops by the same methods the variation in attraction due to ellipsoidal figure, where one of the attracting bodies is an ellipsoid of homogeneous mass, the standard for measuring the variation being the attraction of the mass of the ellipsoid condensed at its own center.

A part of my investigation on attraction, not herein given, develops the variation in attraction due to ellipsoidal figure where the ellipsoid is composed of fluid masses of heterogeneous densities. In this paper I take it as granted that a fluid mass under the law of the mutual attraction of its own component particles, takes on the form of an oblate ellipsoid. In my investigation pertaining to fluid equilibrium I demonstrate under what conditions of rotation the fluid mass assumes the form of an oblate ellipsoid, and also under what conditions of rotation the fluid mass has not defined mathematical figure, but would go back if expanded by heat, to nebula, "without form and void."

In finding the attraction of an ellipsoid on any outside particle or body I avoid the use of the expedient of

confocal ellipsoids. In case, however, the outside particle is in the plane of the equator or line of the poles, it is an evident inference from my investigation that two confocal ellipsoids having their foci at the same points, attract the same particle outside of both, as their masses. In case the outside particle is otherwise located, I have a short and simple demonstration which, if put in at the end of Art. 18 of this paper, would prove that confocal ellipsoids attract any outside particle, as their masses. Todhunter in the second volume of his *History of the Theories of Attraction and the Figure of the Earth,* says, referring to the expedient of confocal ellipsoids: "Legendre we see arrived at his theorem incidentally as he was developing a new demonstration of Laplace's theorem; and the improvement subsequently effected by Ivory in the treatment of Laplace's theorem has probably much diminished the interest which would otherwise have continued to belong to Legendre's. Nevertheless it is to be wished that a simple investigation could be supplied of the remarkable result; and perhaps this may be attained in consequence of thus drawing attention to it."

It is true that the final results of the investigation of this paper reduce to the same as those well known by mathematicians. It is also doubtless true that the modern method of the Calculus is the best for obtaining a specific conclusion. But it seems to me that a new and true geometrical investigation on an intricate subject like this, must furnish another lamp by which can be seen new deductive truths. However this may be, I feel well compensated for the brain force expended in the general mental culture received, and especially in a sharpened ability to detect the fallacious logic in my own scientific and philosophic thought.

2. Two particles at a sensible distance apart attract each other with a force directly proportional to the product of their masses and inversely proportional to the square of their distance. This law is accepted because it is the only law of attraction that accords with physical phenomena.

INVESTIGATION.

I.

SPHERICAL ATTRACTION.

It is proved under Heading I. by demonstration and deduction:

First.— That two homogeneous spheres, or two spheres, each made up in laminæ varying in densities from lamina to lamina, attract each other directly as product of masses, and inversely as square of distance from center to center.

Second.— That a mass composed of fluids under the law of the mutual attraction of component particles, arranges itself, in order of the densities of the fluids, in a sphere made up in laminæ with the most dense at the center.

3. To find the resultant attraction of an assemblage of particles constituting a homogenous sphere on an outside particle.

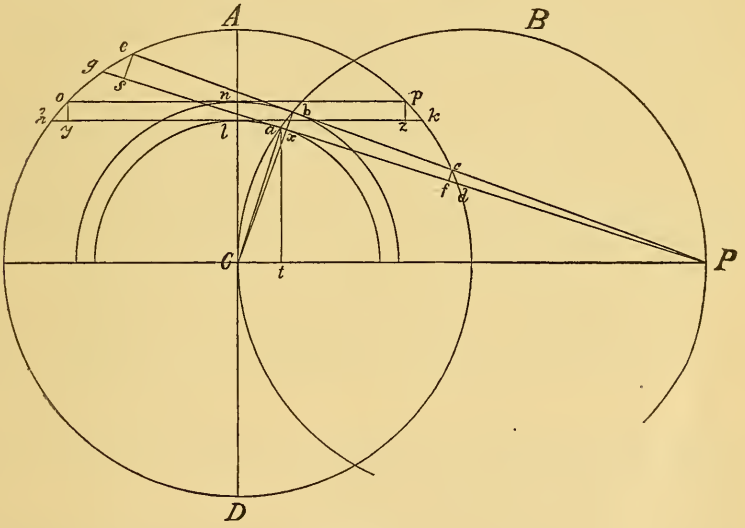

Diagram 1.

In Diagram 1 let C be the center of the sphere, having radius C A, and P the attracted particle. Also let C B P be a circle described on C P as diameter, From P draw any two lines, P g and P e cutting the sphere; also cutting the circumference C B P in points a and b, making the angle g P e infinitesimal. On the radius C A perpendicular to P C, take C l equal to chord C a, and C n equal to C b. Through l and n draw chords h k and o p, parallel to C P. Then chord h k equals chord g d, and o p equals e c. Per law of ultimate ratio when the angle e P g becomes infin-

itesimal, the point x of intersection of chord g d with C b coincides with point a, and a b equals l n.

Draw t a perpendicular to P C. Then angle C P a equals t a C. Let this angle be represented by ϑ. Then is circumference or length of arc generated by point l rotated on axis P C for one rotation or an infinitesimal part of a rotation to circumference or length of arc generated by point a so rotated, as unity to cosine ϑ.

Divide the equal chords g d and h k each into the same number of equal and infinitesimal parts, and from the points of division draw lines as s e, f c, etc., parallel to C a, and y o, z p, etc., parallel to C A. Then for one or an infinitesimal part of a rotation, the volumes generated by surfaces having dimensions a b, s e, f c, etc., each into an equal and infinitesimal division of length along g d, are directly proportional to squares of distances P a, P s, P f, etc. In case then of a sphere of homogeneous density each division along chord g d has a mass directly proportional to the square of its distance from P. Therefore per law of attraction for particles *directly as mass and inversely as square of distance,* the attraction of the mass at any division along chord g d, on particle P is the same as that at division a. The attraction then, in direction P a of whole mass between chords e c and g d, is equal to that of mass at division a into the number of divisions of chord g d into inverse square of distance P a.

Let mass of sphere between chords op and h k rotated be represented by m. Then because h k equals g d, and l n equals a b, and because circumference of point l to circumference of point a rotated is as unity to cosine ϑ, mass of division a into chord g d equals $m \cos \vartheta$. In right angled triangle Pa C let hypothenuse P C be represented by D. Then side Pa equals $D \cos. \vartheta$.

$$\text{Attraction of mass } (m \cos \vartheta) \text{ on P in direction Pa} = \frac{m \cos \vartheta}{D^2 \cos^2 \vartheta}$$

$$\text{Attraction of mass } (m \cos \vartheta) \text{ on P in direction P C} = \frac{m \cos^2 \vartheta}{D^2 \cos^2 \vartheta} = \frac{m}{D^2}$$

But $\frac{m}{D^2}$ equals the attraction of a mass (m) condensed to the size of a particle at the center of the sphere on particle P.

Because P C is the axis of rotation of chords e c and g d, particle P must be attracted in direction P C, and with a force equal to the attraction of the mass cut from the sphere by one rotation of the chords o p and h k, condensed at the center of the sphere.

As n l is any part of the radius A C the whole of a homogeneous sphere attracts an outside particle the same as the mass of the sphere condensed to its center.

4. A spherical shell is a sphere less a sphere of smaller radius. In accordance then, with investigation of Art. 3, a spherical shell attracts an outside particle the same as the mass of the shell condensed at its center.

5. A sphere made up of laminae varying in density from lamina to lamina is the same as a sphere composed of shells having densities corresponding to the laminae. The sphere, then, made up of laminae attracts an outside particle in conformity with the law for spherical shells or a homogeneous sphere.

6. When attracting sphere is condensed to a particle, the investigation of Art. 3 applies to the case where attracted particle P becomes a sphere. Two spheres, therefore, attract each other with a force directly as product of masses and inversely as square of distance from center to center.

7. To find the attraction of a sphere on a particle placed within it.

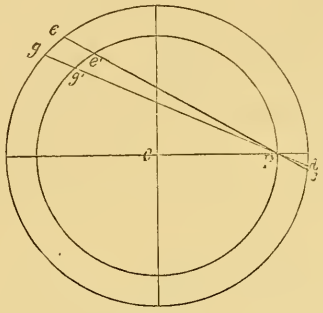

Diagram 2.

Diagram 2 shows particle P within the sphere. It is evident from investigation of Art. 3 that that portion of the sphere outside of the radius distance C P attracts particle P equally in opposite directions. The only uncounterbalanced attraction, then, on particle P is the attraction of that portion of the sphere inside of radius distance C P. Homogeneous spheres of same density vary in masses as cubes of radii. The attraction on particles inside of a homogeneous sphere vary, then, as their distances from the center of the sphere.

8. When the sphere is fluid and particle P becomes a small solid of less density than the sphere, then body P placed at the surface of the sphere floats, and when body P is more dense than the sphere at the surface it sinks. Its place of equilibrium is at the center of the sphere, in case all the laminae of the sphere are less dense than the body P, otherwise in a lamina having the same density as body P.

It is evident that the law of equilibrium requires a fluid mass acted on only by the force of the mutual attraction of component particles to assume a spherical figure, and in case the mass is composed of fluids of varying densities the fluids must take positions in spherical laminae in order of densities, with the most dense at the center.

II.

Preliminary Demonstrations Developing required New Expressions Pertaining to the Ellipse.

First: $A_{,} = B\sqrt{1+E_{,}^{2}\cos^{2}\vartheta} = A\sqrt{1-E^{2}\sin^{2}\vartheta}$

$B_{,} = B\sqrt{1+{}_{,}E_{,}^{2}\sin^{2}\vartheta} = A\sqrt{1-E^{2}\cos^{2}\vartheta}.$

Second: $\sin^{2}\alpha = \dfrac{E^{4}\sin^{2}\vartheta\cos^{2}\vartheta}{1-E^{2}+E^{4}\sin^{2}\vartheta\cos^{2}\vartheta}$

In the above expressions A and B represent the semi-major and semi-minor axes of the ellipse, $A_{,}$ any semi-diameter and $B_{,}$ its semi-conjuegate. E^{2} equals $\frac{A^{2}-B^{2}}{A^{2}}$ and $E_{,}^{2}$ equals $\frac{A^{2}-B^{2}}{B^{2}}$. Angle α is the difference between the angle made by any diameter with its conjugate and a right angle. ϑ is further on defined.

9. *To find any diameter and its conjugate, the major and minor axes of the ellipse being given.*

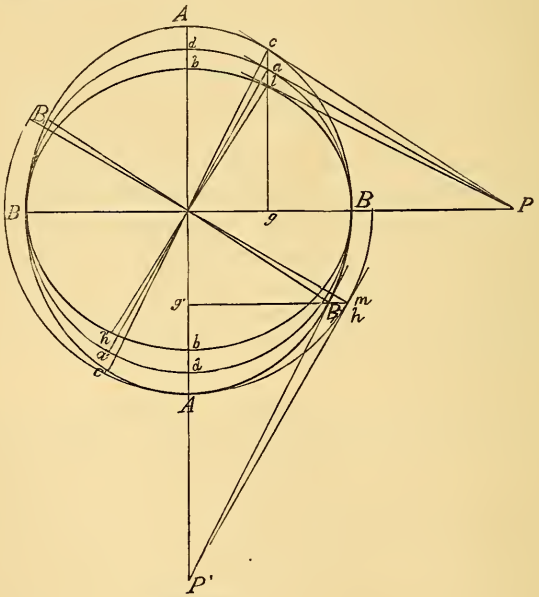

Diagram 3.

In Diagram 3* let A B A B be an ellipse having major axis A A and minor axis B B, and let B b B b be a second ellipse having B B major axis and similar in construction to first ellipse; also let B dB d be a circle with radius B C.

* In center of Diagram 3 C is left out.

Draw the tangent lines P c, P a and P l. Through the points of tangency c, a, l draw line c g so that the part l g is perpendicular to P C. Then by known demonstration of *conic sections* the line c g is straight, and g a is to g c as B to A, also g a is to g l as A to B. Since triangles l P g, a P g, and c P g have each a right angle at g and same base P g, the tangents of the angles l P g, a P g, and c P g are directly as g l, g a, and g c. Since the right angled triangles C l g, C a g, and C c g have the same perpendicular C g, the tangents of the angles C l g, C a g, and C c g are inversely as g l, g a, and g c. But angle a P g equals C a g. therefore angle l P g equals C c g, and angle c P g equals C l g. Also angle c P a equals a C l, and angle a P l equals c C a, and line C l produced is perpendicular to tangent line P c.

Produce major axis A A to P', making distance C P' to C P as A to B. Draw P'm tangent to circle having radius Cm equal to C A, and draw P' $B_,$ tangent to ellipse having axes A A and B B. Through points of tangency m and $B_,$ draw m g'. m g' is perpendicular to P' C and parallel to P C. By constructions angle m P' C equals a P C or C a g. Because then m g' is to $B_,$ g' inversely as A to B, angle C $B_,$ g' equals c P g. Therefore $B_,$ C or $B_,$ $B_,$ is parallel to tangent line P c, and $B_,$ $B_,$ is a conjugate diameter to C $C_,$. The angle c C $B_,$ is greater or less than a right angle by the angle c C l or α.

Let angle C a g be represented by ϑ, C c g by $\vartheta - z$, and C l g by $\vartheta + y$. Hereafter in this investigation ϑ, or the angle in any ellipse in the situation of ϑ, is called the Elliptic Angle, $(\vartheta - z)$ is called the Alpha Elliptic, and $(\vartheta + y)$, the Beta Elliptic Angle.

It is now evident that:

$$Cg = B \sin \vartheta.$$

$$Cg' = A \sin \vartheta.$$

$$ag = B \cos \vartheta.$$

$$cg = \frac{A}{B} B \cos \vartheta = A \cos \vartheta.$$

$$mg' = A \cos \vartheta.$$

$$B_, g' = \frac{B}{A} A \cos \vartheta = B \cos \vartheta.$$

In right angled triangle C c g;

$$C\,c = A_, = \sqrt{A^2 \cos^2 \vartheta + B^2 \sin^2 \vartheta} = \sqrt{B^2 + (A^2 - B^2) \cos^2 \vartheta} =$$

$$\sqrt{A^2 - (A^2 - B^2) \sin^2 \vartheta}.$$

$$A_, = B \sqrt{1 + E_,^2 \cos^2 \vartheta} = A \sqrt{1 - E^2 \sin^2 \vartheta}.$$

Likewise from right angled triangle C $B_,$ g',

$$B_, = B \sqrt{1 + E_,^2 \sin^2 \vartheta} = A \sqrt{1 - E^2 \cos^2 \vartheta}.$$

10. *To find an expression for sine square of angle* α.

In triangle c C l,

$$\sin \alpha = \frac{\sin (\vartheta + y)\, \overline{c\,l}}{A_{,}}$$

$$c\,l = A \cos \vartheta - \frac{B^2 \cos \vartheta}{A} = A\,E^2 \cos \vartheta.$$

$$\sin (\vartheta + y) = \frac{A \sin \vartheta}{B_{,}}$$

$$\sin^2 \alpha = \frac{A^4\, E^4 \sin^2 \vartheta \cos^2 \vartheta}{A_{,}^2\, B_{,}^2} = \frac{E^4 \sin^2 \vartheta \cos^2 \vartheta}{(1 - E^2 \sin^2 \vartheta)(1 - E^2 \cos^2 \vartheta)}$$

$$\sin^2 \alpha = \frac{E^4 \sin^2 \vartheta \cos^2 \vartheta}{1 - E^2 + E^4 \sin^2 \vartheta \cos^2 \vartheta}$$

III.

OUTSIDE ELLIPSOIDAL ATTRACTION IN LINE OF POLES.

First.—An oblate Ellipsoid and an outside particle in line of the poles attract each other directly as product of mass of particle into mass of Ellipsoid multiplied by $(1 - \frac{3}{5} n^2 E_{,}^2 + \frac{3}{7} n^4 E_{,}^4 - \frac{3}{9} n^6 E_{,}^6 + \text{etc.})$ *and inversely as sguare of distance from center of ellipsoid to particle.**

Second.—A prolate ellipsoid and an outside particle in line of the poles attract each other directly as product of mass of particle into mass of ellipsoid multiplied by $(1 + \frac{3}{5} n^2 E^2 + \frac{3}{7} n^4 E^4 + \frac{3}{9} n^6 E^6 + \text{etc.})$ *and inversely as square of distance.*

In the first case n equals the minor axis of the ellipsoid divided by the distance and in the second, the major axis divided by distance, $E_{,}^2$ equals E^2 divided by $(1 - E^2)$.

11. To find the attraction of an ellipsoid of rotation on an outside particle in line of axis of rotation.

In Diagram 4 let C be the center of the ellipsoid having major axis A A and minor axis B B , and let P be the attracted particle.

On P C as minor axis described a semi ellipse, similar to the one having C for its center. Also with C as the center and n C and l C as semi major axes describe two semi ellipses similar to ones already de-

*When not otherwise mentioned the ellipsoid is homogeneous. The word particle here used represents finite mass condensed to the dimensions of a particle.

scribed. The construction of the remaining portions of the diagram where not evident is explained.

Draw B, B, parallel to P a, and draw A, A, through point of tangency a and center C. A, A, and B, B, are, then, conjugate diameters.

Ordinate a d equals ordinate a g, l k equals l h. Per known demonstration of *Conic Sections;*

(*a*) g d : h k :: B, : B.

When the angle e P g becomes infinitesimal, A, A, passes through the points of tangency a and b. From the similarity of the ellipses having C l, C n, and C A for semi major axes; b a : n l :: A, : A. Draw s x through point a, and perpendicular to P a. Then s a = b a cos α

(*b*) s a : n l :: A, cos. α : A.

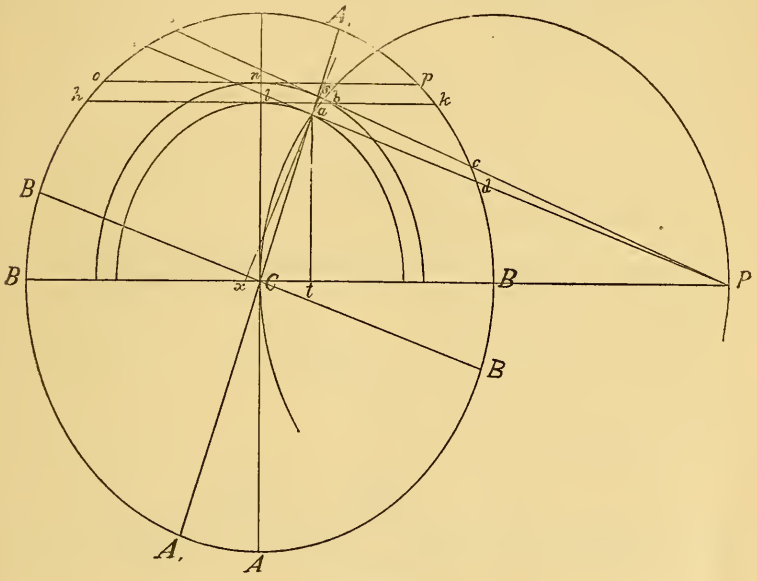

Diagram 4.

Draw t a perpendicular to P C. Per Art. 9, t a = C l cos. ϑ. Then from the similarity of the ellipses;

(*c*) t a : C l :: A cos. ϑ : A.

The product of the proportions (a) (b) (c) gives;

g d $\times$ s a $\times$ t a : h k $\times$ n l $\times$ C l :: A A, B, cos ϑ cos α : A^2 B :: cos ϑ : 1.

The last ratio is true because A, B, cos α = A B.

In accordance with a demonstration in Art. 3, g d $\times$ s a $\times$ t a represents a mass at point a, that attracts particle P in direction P a the same as the mass cut from the ellipsoid by rotating chords e c and g d on axis P C; and h k $\times$ n l $\times$ C l represents a mass (m) from likewise rotating chords o p and h k.

Angle C a P equals $(90°-\alpha)$, and angle a C P equals $90°-(\vartheta-z)$. Let C P equal D. Then in triangle C a P, $Pa = D\frac{\cos(\vartheta-z).}{\cos\alpha}$

Attraction of mass $(m\cos\vartheta)$ in direction Pa on $P = \frac{m\cos\vartheta\cos^2\alpha}{D^2\cos^2(\vartheta-z)}$

Attraction of mass in direction $PC = \frac{m\cos\vartheta\cos(\vartheta+y)\cos^2\alpha}{D^2\cos^2(\vartheta-z)}$

In triangle C c g, Diagram 3.

$$\cos(\vartheta-z) = \frac{A\cos\vartheta}{A_,}$$

In triangle C B, g, Diagram 3.

$$\cos(\vartheta+y) = \frac{B\cos\vartheta}{B_,}$$

Attraction, etc., $= \frac{M}{D^2}\times\frac{A_,^2 B\cos^2\alpha}{A^2 B_,}$

$A_,^2 B_,^2\cos^2\alpha = A^2 B^2$, or $\frac{A_,^2}{A^2} = \frac{B^2}{B_,^2\cos^2\alpha}$

In case then of an oblate ellipsoid,

Attraction of mass $(m\cos\vartheta)$ in direction P C on $P = \frac{m}{D^2}\times\frac{B^3}{B_,^3}$

Likewise for a prolate ellipsoid,

Attraction of mass $(m'\cos\vartheta)$ etc., $= \frac{m'}{D_,^2}\times\frac{A^3}{A_,^3}$

$$\frac{B^3}{B_,^3} = \frac{B^3}{B^3(1+E_,^2\sin^2\vartheta)^{\frac{3}{2}}} = (1+E_,^2\sin^2\vartheta)^{-\frac{3}{2}}$$

$$(1+E_,^2\sin^2\vartheta)^{-\frac{3}{2}} = 1-\frac{3}{2}E_,^2\sin^2\vartheta+\frac{3.5}{2.4}E_,^4\sin^4 - \frac{3.5.7}{2.4.6}E_,^6\sin^6\vartheta+\text{etc.}$$

$$\frac{A^3}{A_,^3} = (1-E^2\sin^2\vartheta)^{-\frac{3}{2}} = 1+\frac{3}{2}E^2\sin^2\vartheta+\frac{3.5}{2.4}E^4\sin^4\vartheta+\frac{3.5.7}{2.4.6}E^6\sin^6\vartheta+\text{etc.}$$

For oblate spheroid,

Attraction of mass $(m\cos\vartheta)\&c = \frac{M}{D^2}(1-\frac{3}{2}E_,^2\sin^2\vartheta+\frac{3.5}{2.4}E_,^4\sin^4\vartheta-\text{etc.}$

For prolate ellipsoid,

Attraction of mass $(m'\cos\vartheta)\&c. = \frac{M'}{D_,^2}(1+\frac{3}{2}E^2\sin^2\vartheta+\frac{3.5}{2.4}E^4\sin^4\vartheta+\text{etc.}$

12. In the above expressions for attraction any power of E or $E_,$ is a constant for any part or the whole of the same ellipsoid, while any power of $\sin\vartheta$ varies from 0 to 1. In case of the oblate ellipsoid having a constant semi minor axis (B) mass (m) varies as A^2, or as the mass of the whole ellipsoid till the ellipsoid becomes a sphere. The same relation is true of the

prolate spheroid. The coefficients, then, for eccentricity square, fourth power, etc., for the ellipsoid can be correctly computed from a sphere.

If we should represent the mass of the sphere by unity, and compute the fractional masses cut from the sphere by rotating a system of chords comprising an infinite number, extending from A to C and perpendicular to radius A C, and multiply each of the fractions by its requisite $\sin^2 \vartheta$, the sum of the products would be the value for $\sin^2 \vartheta$ for the whole of an ellipsoid. The same method is likewise true for computing the average value for any power of sin ϑ. Let $\sin^2 \psi_2$, $\sin^4 \psi_4$, $\sin^6 \psi_6$, etc., be the average values for $\sin^2 \vartheta$, $\sin^4 \vartheta$, $\sin^6 \vartheta$, etc., for the whole of a homegeneous ellipsoid with the attracted particle at the surface.

By using certain expedients wonderfully abbreviating the just described system of computation, I get the exact numerical values for $\sin^2 \psi_2$, $\sin^4 \psi_4$, $\sin^6 \psi_6$, &c., and also for $\cos \psi_1$, $\cos^2 \psi_2$, $\cos^3 \psi_3$, &c. Which are:

*$\mathrm{Sin}^2 \psi_2 = \frac{2}{5}$.

$\mathrm{Sin}^4 \psi_4 = \frac{2.4}{5.7}$.

$\mathrm{Sin}^6 \psi_6 = \frac{2.4.6}{5.7.9}$.

$\mathrm{Sin}^8 \psi_8 = \frac{2.4.6.8}{5.7.9.11}$, &c. for higher powers.

$\mathrm{Cos}\ \psi_1 = \frac{3}{4}$.

$\mathrm{Cos}^2 \psi_2 = \frac{3}{5}$.

$\mathrm{Cos}^3 \psi_3 = \frac{3}{6}$.

$\mathrm{Cos}^4 \psi_4 = \frac{3}{7}$ &c. for higher powers.

The expression for the attraction of the whole mass (M) of an oblate ellipsoid on a particle at the pole reduces to:

$$\frac{M}{B^2}\left(1 - \frac{3}{5}E_{,}^{2} + \frac{3}{7}E_{,}^{4} - \frac{3}{9}E_{,}^{6} + \text{etc}\right).$$

The expression, &c., for the prolate ellipsoid becomes:

$$\frac{M'}{A^2}\left(1 + \frac{3}{5}E^2 + \frac{3}{7}E^4 + \frac{3}{9}E^6 + \text{etc}\right).$$

13. Let $\frac{B}{D}$ or $\frac{A}{D}$ be represented by n. Since in a right angled triangle having a constant perpendicular while its hypothneuse and base increase in length, the sine of the angle at the base diminishes as the hypothenuse increases, and as each and all the angles ϑ that make up the angle ψ_2 are

*How these results are obtained is fully explained in the investigations on the subject referred to at the beginning of this paper.

from right angled triangles that have a common hypothenuse and each continues to have the same length of perpendicular as hypothenuse increases, therefore $\sin^2 \psi_2$ representing the average of all the $\sin^2 \vartheta$ varies as n^2. It can be shown likewise for $\sin^4 \psi_4$, etc., which represent the averages of all $\sin^4 \vartheta$, etc., that they vary as n^4, n^6, etc.

The expression, then, for the attraction of an oblate ellipsoid on a particle outside the pole is:

$$\frac{M}{D^2}\left(1-\frac{3}{5}n^2\,E_{,}^{\,2}+\frac{3}{7}n^4\,E_{,}^{\,4}-\frac{3}{9}n^6\,E_{,}^{\,6}+\text{etc.}\right)$$

The expression, etc., for prolate ellipsoid is:

$$\frac{M}{D_{,}^{\,2}}\left(1+\frac{3}{5}n^2E^2+\frac{3}{7}n^4E^4+\frac{3}{9}n^6\,E^6+\text{etc.}\right)$$

IV.

OUTSIDE ELLIPSOIDAL ATTRACTION IN PLANE OF THE EQUATOR.

First.—An oblate ellipsoid and an outside particle in plane of the equator attract each other directly as product of mass of particle into mass of ellipsoid multiplied by $\left(1+\frac{1}{2}\times\frac{3}{5}\,n^2E^2+\frac{3}{2.4}\times\frac{3}{7}\,n^4E^4+\frac{3.5}{2.4.6}\times\frac{3}{9}\,n^6E^6+\text{etc.}\right)$ *and inversely as square of distance from center of ellipsoid to particle.*

Second.—A prolate ellipsoid and an outside particle in the plane of the equator attract each other directly as product of mass of particle into mass of ellipsoid multiplied by $\left(1-\frac{1}{2}\times\frac{3}{5}\,n^2\,E_{,}^{\,2}+\frac{3}{2.4}\times\frac{3}{7}n^4E_{,}^{\,4}-\frac{3.5}{2.4.6}\times\frac{3}{9}\,n^6\,E_{,}^{\,6}+\text{etc.}\right)$, *and inversely as sguare of distance.*

14. This article finds a method of dividing an ellipsoid into an infinite number of wedges equal each to each, where the edges of the wedges are in an equatorial diameter.

In Diagram 5 let AB AB be a section of ellipsoid passing through the center of the ellipsoid and at rightangles to an equatorial diameter. Draw lines C a, C a^1, C a^2, etc., so that angles A C a, A C a^1, A C a^2, etc., can be represented by the alpha elliptic angles ϑ—z, ϑ_1—z_1, ϑ_2—z_2, etc.; also draw lines C b, C b_1, C b_2, etc., so that angles B C b, B C b_1, B C b_2, etc., can be represented by the beta elliptic angles ϑ+y, ϑ_1+y_1, ϑ_2+y_2, etc. When the elliptic angle becomes 45° then the z angle equals the y angle.

In Diagram 3 angle A C c or C c g corresponds to angle A C a of Dia. 5, and angle A C l or C l g of Dia. 3, to angle B C b of Dia. 5. In triangles C c g and C l g (Dia. 3), c g = A cos ϑ, and l g = $\frac{B^2}{A}$ cos ϑ.

tan C c g : tan C l g :: $\frac{B^2}{A}$ cos ϑ : A cos ϑ :: $B^2 : A^2$, or tan A C a : tan B C b :: $B^2 : A^2$.

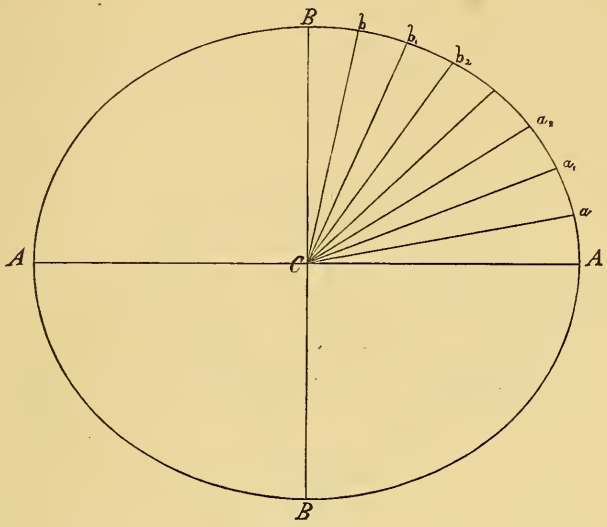

Diagram 5.

When the angles A C a and B C b become infinitesimal they are to each other as their tangents. Therefore infinitesimal angle A C a : angle B C b :: $B^2 : A^2$

The volume, then, of the wedge of the elipsoid measured by $A \times A^2 \times \frac{\text{ang. A Ca}}{360°}$ equals that measured by $A \times B^2 \times \frac{\text{ang. B Cb}}{360°}$ in case of the oblate ellipsoid. Likewise obtained, in the case of the prolate ellipsoid: $B \times A^2 \times \frac{\text{ang. A Ca}}{360°} = B \times B^2 \times \frac{\text{ang. B Cb}}{360°}$.

In Diagram 6 let A B A B be an ellipse having semi diameter C B, equal to ($B_,$), and B, b, B, b, a similar ellipse having C B, equal to ($a_,$). also let B, a B, be a circle with radius C B,. From any point P in line C B, produced, draw tangent lines P $A_{,,}$, Pa, Pb$_{,,}$, and from points of tangency $A_{,,}$, a, and b$_{,,}$, draw C$A_{,,}$ Ca, and Cb$_{,,}$. Draw C $B_{,,}$ parallel to $A_{,,}$ P, and C$a_{,,}$ parallel to b$_{,,}$ P. Then C $A_{,,}$ ($A_{,,}$) and C $B_{,,}$ ($B_{,,}$) are semi conjugate diameters in the one ellipse, and C b$_{,,}$ (b$_{,,}$) and C$a_{,,}$ ($a_{,,}$) are corresponding semi conjugate diameters in the other.

Form points $A_{,,}$, a, and $b_{,,}$, draw ordinates to diameter $B_{,}$ $B_{,}$. These ordinates intersect diameter $B_{,}$ $B_{,}$ in a common point g, and C a g is an elliptic angle. a g$=B_{,}\cos\vartheta$, $A_{,,}$ g$=A_{,}\cos\vartheta$, and $b_{,,}$ g$=\frac{B_{,}^2}{A_{,}}\cos\vartheta$.

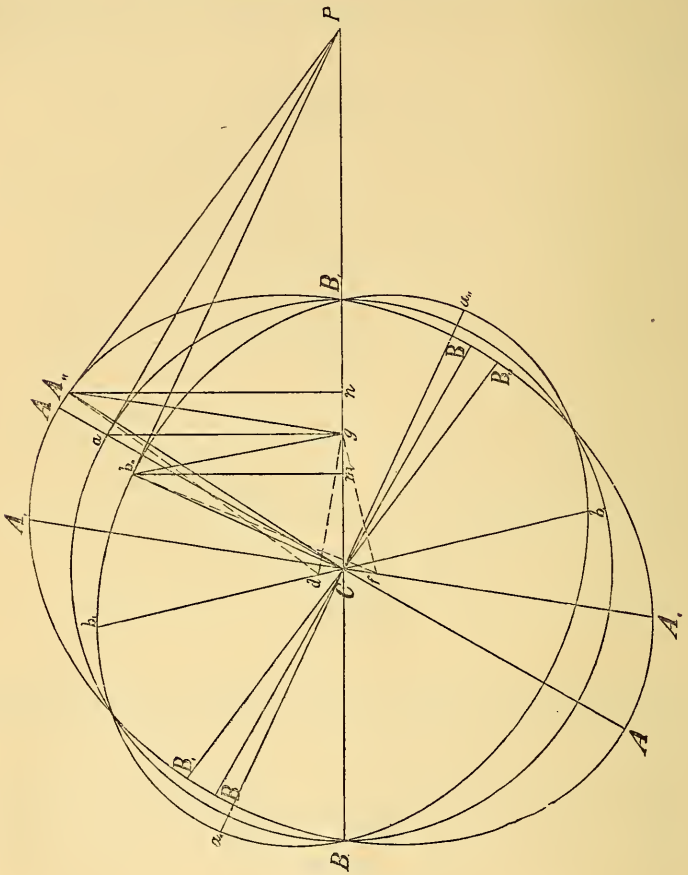

Diagram 6.

The ordinate $A_{,,}$ g being parallel to to $A_{,}$ C ($A_{,}$), the angle C $A_{,,}$ g is equal to the angle $A_{,}$ C $A_{,,}$ or the angle that $A_{,}$ makes with $A_{,,}$. Also $b_{,,}$ g being parallel to $b_{,}$ C, the angle C $b_{,,}$ g is equal to the angle that $b_{,}$ makes with $b_{,,}$.

Draw $A_{,,}$ n and $b_{,,}$ m perpendicular to diameter $B_{,}$ $B_{,}$. Then 90° plus or minus the angle g $b_{,,}$ m or g $A_{,,}$ n (α) equals the angle that $A_{,}$ makes with $B_{,}$. Draw g d and g f each equal in length to g C, having angles d g C and f g C each equal to angle α. Then from the right angled triangles d $A_{,,}$ g and f $b_{,,}$ g having perpendicular d g equal to f g,:

$$\text{tan d } A_{,,}\text{ g} : \text{tan f } b_{,,}\text{ g} :: \frac{B_{,}^2}{A_{,}}\cos\vartheta : A_{,}\cos\vartheta :: B_{,}^2 : A_{,}^2.$$

When angle ϑ becomes infinitesimal points d and f coincide with point C, and angle d $A_{\prime\prime}$g equals C $A_{\prime\prime}$g, and f $b_{\prime\prime}$g equals C $b_{\prime\prime}$g. Therefore infinitesimal angles C $A_{\prime\prime}$g: C $b_{\prime\prime}$g :: $B_{\prime}^2$: $A_{\prime}^2$

Form Art. 10,

$A_{\prime}^2 = A^2 - (A^2 - B^2) \sin^2 \vartheta.$

$B_{\prime}^2 = B^2 + (A^2 - B^2) \sin^2 \vartheta.$

Then $A_{\prime}^2 + B_{\prime}^2 = A^2 + B^2.$

Angle C $A_{\prime\prime}$g represents any of the angles a C $a_{\prime}$, $a_{\prime}$ C a_2 etc., and C $b_{\prime\prime}$g, any of the corresponding angles b C $b_{\prime}$, $b_{\prime}$ C b_2, etc., of Dia. 5. The volume of infinitesimal wedge then from an oblate ellipsoid measured by $A \times A_{\prime}^2 \times \frac{\text{Ang. a C } a_{\prime}}{360^\circ}$ equals that measured by $A \times B_{\prime}^2 \times \text{Ang.} \frac{b\ C\ b_{\prime}}{360^\circ}$

As $A_{\prime}^2 + B_{\prime}^2 = A^2 + B^2$, the iufinitesimal wedges of prolate ellipsoids, the sums of which make up the oblate ellipsoid are equal, each to each, in volume. The same can likewise be proved of wedges of a prolate ellipsoid.

15. To find, for any even power, an expression for the average of the eccentricities of all the infinitesimal wedges composing an ellipsoid, with edges in an equatorial diameter.

The edges of the elliptic wedges have a common semi-axis A and the other semi-axis varies from A to B as $A_{\prime}$ or $B_{\prime}$ vary from A to B.

$B_{\prime}$ for angle ϑ equals $A_{\prime}$ for angle $(90^\circ - \vartheta)$.

Eccentricity $\frac{A^2 - A_{\prime}^2}{A^2} = \frac{A^2 - B^2}{A^2} \sin^2 \vartheta = E^2 \sin^2 \vartheta = E^2 \cos^2 (90^\circ - \vartheta).$

Eccentricity $\frac{A^2 - B_{\prime}^2}{A^2} = \frac{A^2 - B^2}{A^2} \cos^2 \vartheta = E^2 \cos^2 \vartheta = E^2 \sin^2 (90^\circ - \vartheta).$

$$\frac{A^2 - A_{\prime}^2}{A^2} + \frac{A^2 - B_{\prime}^2}{A^2} + \frac{A^2 - A_2^2}{A^2} + \frac{A^2 - B_2^2}{A^2} + \frac{A^2 - A_3^2}{A^2} + \frac{A^2 - B_3^2}{A^2} + \text{\&c. to } 45^\circ,$$

Divided by the number of wedges equals,

$E^2(\sin^2 \vartheta + \cos^2 \vartheta + \sin^2 \vartheta_{\prime} + \cos^2 \vartheta_{\prime} + \sin^2 \vartheta_2 + \cos^2 \vartheta_2 + \text{\&c to } 45^\circ),$

divided by the number of wedges.

Trigonometry gives:

$\sin^2 \vartheta = \frac{1}{2} - \frac{1}{2} \cos 2\vartheta.$

$\cos^2 \vartheta = \frac{1}{2} + \frac{1}{2} \cos 2\vartheta.$

$$\frac{\sin^2 \vartheta + \cos^2 \vartheta}{2} = \tfrac{1}{2} = \sin^2 45^\circ = \cos^2 45.^\circ$$

The value $\frac{1}{2}$ is true for any pair of wedges. It is therefore the true value for the coefficient of E^2 in the expression $E^2 \sin^2 \vartheta$ which gives $\frac{1}{2} E^2$ for the average eccentricity squared of all wedges.

$\frac{(A^2 - A_{\prime}^2)^2}{A^4} + \frac{(A^2 - B_{\prime}^2)^2}{A^4}$ + etc., to ϑ for $45,^\circ$ divided by number of wedges, equals $E^4 (\sin^4 \vartheta + \cos^4 \vartheta)$ + etc., to ϑ for $45,^\circ$ divided by number of wedges.

$$\sin^4 \vartheta = \frac{1}{2^2} - \frac{1}{2} \cos 2\vartheta + \frac{1}{2^2} \cos^2 2\vartheta.$$

$$\cos^4 \vartheta = \frac{1}{2^2} + \frac{1}{2} \cos 2\vartheta + \frac{1}{2^2} \cos^2 2\vartheta.$$

$$\frac{\sin^4 \vartheta + \cos^4 \vartheta}{2} = \frac{1}{2^2} + \frac{1}{2^2} \cos^2 2\vartheta.$$

The first term $\left(\frac{1}{2^2}\right)$ of the above result is true for any value given to ϑ from 0° to 45°; therefore $\frac{1}{2^2}$ is the average for that term. It is now required to find the average of the succession of terms, $\frac{1}{2^2} \cos^2 2\vartheta + \frac{1}{2^2} \cos^2 2\vartheta_{,} + \frac{1}{2^2} \cos 2\vartheta_{,,}$ + etc., to ϑ for 45°. When ϑ becomes 45°, 2ϑ becomes 90°; therefore these terms can be put in shape as follows: $\frac{1}{2^2}[\cos^2 2\vartheta + \cos^2 (90° - 2\vartheta) + \cos^2 2\vartheta_{,} + \cos^2 (90° - 2\vartheta_1) + \cos^2 2\vartheta_{,} + \cos^2 (90° - 2\vartheta_2)$ + etc., to 2ϑ equal 45°], divided by the number of terms. The average value, then, for $\cos^2 2\vartheta$ is $\frac{1}{2}$. The average value of

$$\frac{1}{2^2} + \frac{1}{2^2} \cos^2 2\vartheta = \tfrac{1}{4} + \tfrac{1}{4} \times \tfrac{1}{2} = \tfrac{3}{8} = \frac{3}{2.4}$$

By like computation the average value of

$$\frac{\sin^6 \vartheta + \cos^6 \vartheta}{2} = \frac{1}{2^3} + \frac{3}{2^3} \cos^2 2\vartheta = \frac{15}{48} = \frac{3.5}{2.4.6}.$$

$$\frac{\sin^8 \vartheta + \cos^8 \vartheta}{2} = \frac{3.5.7}{2.4.6.8}.$$

$$\frac{\sin^{10} \vartheta + \cos^{10} \vartheta}{2} = \frac{3.5.7.9}{2.4.6.8.10},$$ etc., for higher powers.

For each of the infinitisimal wedges of an oblate ellipsoid, mass and distance squared are constant factors. The expression then for the attraction of an oblate ellipsoid on a particle outside in the plane of the equator is:

$$\frac{M}{D^2}\left(1 + \frac{1}{2} \times \frac{3}{5} n^2 E^2 + \frac{3}{2.4} \times \frac{3}{7} a^4 E^4 + \text{etc.}\right).$$

For a prolate ellipsoid, etc.:

$$\frac{M'}{D_{,}^2}\left(1 - \frac{1}{2} \times \frac{3}{5} n^2 E_{,}^2 + \frac{3}{2.4} \times \frac{3}{7} n^2 E_{,}^2 - \text{etc.}\right).$$

V.

COMPARISON OF ATTRACTION AT POLE AND EQUATOR, AND ATTRACTION OF CONFOCAL ELLIPSOIDS.

First. On an oblate ellipsoid the attraction at the pole exceeds that at the equator by $\frac{M}{A^2}\left(\frac{1}{10}E^2+\frac{19}{280}E^4+\frac{27}{560}E^6+\frac{163}{4480}E^8+_{\prime\prime}\right)$ or by

$$\frac{M}{A^2}\left(\frac{1}{5}h+\frac{6}{35}h^2+\frac{4}{35}h^3+\frac{1}{14}h^4+_{\prime\prime}\right)$$

Second. On a prolate ellipsoid the attraction at the equator exceeds that at the pole by $\frac{M}{A^2}\left(\frac{1}{10}E^2+\frac{37}{280}E^4+\frac{229}{1680}E^6+_{\prime\prime}\right)$ or by $\frac{M}{A^2}\left(\frac{1}{5}h+\frac{3}{7}h^2+_{\prime\prime}\right)$

Third. Confocal ellipsoids having foci at same points attract an outside particle in line of poles or plane of the equators directly as their masses.

In the above enunciations h equals $\frac{A-B}{A}$ or E^2 equals h (2—h).

16. The expression for the attraction at the pole of an oblate ellipsoid is

$$\frac{M}{B^2}\left(1-\frac{3}{5}E_{,}+\frac{3}{7}E_{,}^4-\frac{3}{9}E_{,}^6+\text{etc.}\right)$$ By substituting.

$\frac{E^2}{1-E^2}$ for $E_{,}^2$ and $A^2(1-E^2)$ for B^2, the expression becomes,

(a) $$\frac{M}{A^2}\left(1+\frac{2}{5}E^2+\frac{2.4}{5.7}E^4+\frac{2.4.6}{5.7.9}E^6+\text{etc.}\right)$$

The expression for the same oblate ellipsoid at the equator is:

(b) $$\frac{M}{A^2}\left(1+\frac{1}{2}\times\frac{3}{5}E^2+\frac{3}{2.4}\times\frac{3}{7}E^4+\frac{3.5}{2.4.6}\times\frac{3}{9}E^6+\text{etc.}\right)$$

Subtract expression (b) from (a) and the difference is:

$$\frac{M}{A^2}\left(\frac{1}{10}E^2+\frac{19}{280}E^4+\frac{27}{560}E^6+\frac{163}{4480}E^8+_{\prime\prime}\right)$$

By substituting as above for $E^2_{,}$ and for B^2, the expression for the prolate ellipsoid at the equator becomes:

(c) $$\frac{M}{A^2}\left(1+\frac{7}{10}E^2+\frac{157}{280}E^4+\frac{263}{560}E^6+''\right)$$

The expression for Pole is:

(d) $$\frac{M}{A^2}\left(1+\frac{3}{5}E^2+\frac{3}{7}E^4+\frac{3}{9}E^6+\text{etc.}\right)$$

$$\frac{M}{A^2}\left(\frac{1}{10}E^2+\frac{37}{280}E^4+\frac{229}{1680}E^6+''\right)$$

equals difference.

17. To find the relation in law of attraction existing between two confocal ellipsoids having the same foci on a particle outside of both and in line of poles or plane of equator.

Let the semi major and the semi minor axes in the one be represented by a and b, and in the other by A and B.

$$e_{,}^{2}=\frac{a^2-b^2}{b^2}$$

$$E_{,}^{2}=\frac{A^2-B^2}{B^2}$$

$$e_{,}^{2} : E_{,}^{2} :: \frac{a^2-b^2}{b^2} : \frac{A^2-B^2}{B^2}$$

Since the ellipsoids are confocal.

$$a^2-b^2=A^2-B^2.$$

(a) $e_{,}^{2} : E_{,}^{2} :: \frac{1}{b^2} : \frac{1}{B^2}.$

(b) $e_{,}^{4} : E_{,}^{4} :: \frac{1}{b^4} : \frac{1}{B^4}$, etc. for higher powers.

It is evident from construction of right angled triangle Pa C in Dia. 4 that any sin ϑ for ellipsoid having ecentricity $e_{,}^{2}$ is to corresponding sin ϑ for ellipsoid having eccentricity $E_{,}^{2}$ as b to B. therefore

(c) $\sin^2 \vartheta : \sin^2 \vartheta_{,} :: b^2 : B^2$

(d) $\sin^4 \vartheta :: \sin^4 \vartheta' , : b^4 : B,^4$ etc. for higher powers.

Product of (a) and (c) is,

$$e_{,}^{2} \sin^2 \vartheta : E_{,}^{2} \sin^2 \vartheta_{,} :: \frac{b^2}{b^2} : \frac{B^2}{B^2} :: 1 : 1.$$

Product of (b) and (d) is,

$$e_{,}^{4} \sin^4 \vartheta : E_{,}^{4} \sin^4 \vartheta_{,} :: \frac{b^4}{b^4} : \frac{B^4}{B^4} : 1 : 1.$$

etc. for higher powers.

$$e_{,}^{2} \sin^2 \vartheta + e_{,}^{4} \sin^4 \vartheta + \text{etc} : E_{,}^{2} \sin^2 \vartheta_{,} + E_{,}^{4} \sin^4 \vartheta' , + \text{etc.} :: 1 : 1.$$

This proves that confocal oblate ellipsoids attract an outside particle in line of poles directly as their masses.

Likewise it can be proven that confocal prolate ellipsoids in line of axis of rotation attract in conformity with law of masses.

As an ellipsoid can be made up of infinitesimal ellipsoidal wedges with edges in an equatorial diameter, confocal ellipsoids attract an outside particle in plane of equators as their masses.

It is evident that this law holds true for confocal ellipsoids made up of laminae varying in density from lamina to lamina providing corresponding laminae of each ellipsoid are of same density.

VI.

OUTSIDE ELIPSOIDAL ATTRACTION IN ANY DIRECTION.

First. — *An oblate ellipsoid and any outside partiele attract each other directly as product of mass of particle into mass of ellipsoid multiplied by* $[1-\frac{3}{5}n^2E^2(1-\frac{3}{2}\sin^2 O)-\frac{3}{5}E^4(n^2-\frac{5}{7}n^4+\frac{3}{5}\sin^2 O-\frac{3}{5}\sin^4 O-4n^2\sin^2 O+3n^2\sin^4 O+\frac{187}{70}n^4\sin^2 O-\frac{89}{40}n^4\sin^4 O)+{}_{\prime\prime}]$ *and inversely as square of distance from center of ellipsoid.*

Second — *The sine of the angle made by the direction of the resultant attraction, and the direction from the particle to the center of the ellipsoid equals* $\frac{3}{5}n^2E^2\sin O\cos O\,[1+E^2(\frac{3}{2}-2\sin^2 O-\frac{4}{7}n^2+\frac{23}{20}n^2\sin^2 O)+{}_{\prime\prime}]$.

Third — *The increase in attraction on an oblate ellipsoid from the equator to the poles true to the fourth power of eccentricilty varies as the square of the sine of the elliptic angle.*

In the above enunciations, n equals $B_{,}$ divided by D (distance), and O represents the elliptic angle used to find $B_{,}$.

18. To find an expression for the attraction on any outside particle, of any two opposite infinitesimal wedges of an ellipsoid with the edges in the diameter extending in direction to the particle.

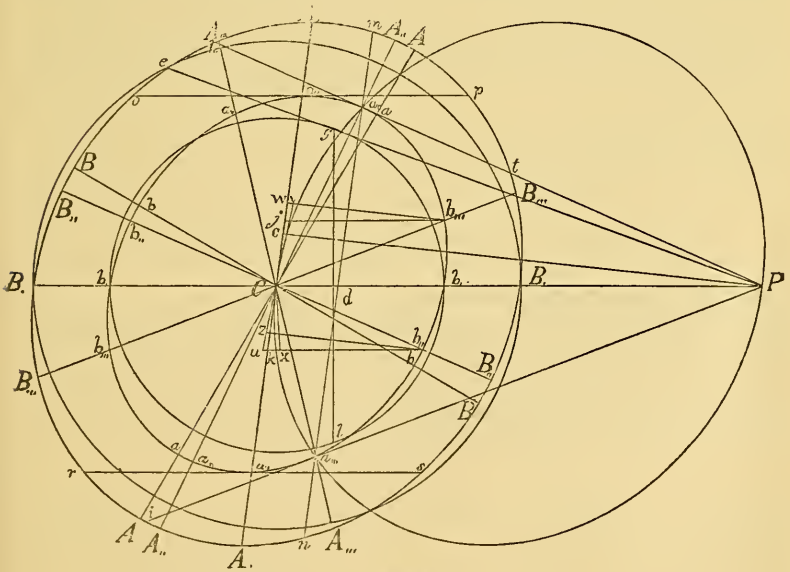

Diagram 7.

In diagram 7 let $B_{,}$ $B_{,}$ be the diameter of the ellipsoid extending in direction to the outside particle (P), A A and B B being the principal axes of the ellipsoid. This elliptic section rotated on axis $B_{,}$ $B_{,}$ through an in-

finitesimal angle represents the two opposite wedges in the plane of the principal axes. With C as a center and a a and b b as principal axes describe an ellipse similar to one having axes A A and B B, also describe circles with radii C $b_{,}$ and C $B_{,}$. On C P as a diameter corresponding to $B_{,}$ $B_{,}$ as a diameter describe another similar ellipse. From P draw Ph and Pi tangent lines to the ellipse having axes a a and b b. Draw diameter $B_{,,}$ $B_{,,}$ or $b_{,,}$ $b_{,,}$ parallel to tangent Ph, also diameter $B_{,,,}$ $B_{,,,}$ or $b_{,,,}$ $b_{,,,}$ parallel to tangent Pi. Through the points of tangency $a_{,,}$ and the center C draw the diameter $A_{,,}$ $A_{,,}$ or $a_{,,}$ $a_{,,}$, then $A_{,,}$ $A_{,,}$ and $B_{,,}$ $B_{,,}$ or $a_{,,}$ $a_{,,}$ and $b_{,,}$ $b_{,,}$ are conjugate diameters. $A_{,,,}$ $A_{,,,}$ and $B_{,,,}$ $B_{,,,}$ or $a_{,,,}$ $a_{,,,}$ and $b_{,,,}$ $b_{,,,}$ are likewise conjugate diameters. Through the points of tangency $a_{,,}$ and $a_{,,,}$ draw line m n, and diameter $A_{,}$ $A_{,}$ parallel to m n, then $A_{,}$ $A_{,}$ and $B_{,}$ $B_{,}$ or $a_{,}$ $a_{,}$ and $b_{,}$ $b_{,}$ are conjugate diameters, and $a_{,,}$ d and $a_{,,,}$ d are equal ordinates. From P draw line Pe tangent to the circle having radius C $b_{,}$, and from point of tangency g draw line g d l; then line g l is perpendicular to diameter $B_{,}$ $B_{,}$ and a double ordinate.*

From known demonstrations of *Conic Sections*,

g d : $a_{,,}$d :: $b_{,}$: $a_{,}$ :: $B_{,}$: $A_{,}$.

Draw radius g C and let angle C g d or its equal g P C be represented by ϑ. Then because g d = $b_{,}$ cos ϑ, and $a_{,,}$d = $a_{,}$ cos ϑ,

Thickness of elliptic wedge at $a_{,}$ is to that at $a_{,,}$ as $a_{,}$: $a_{,}$ cos ϑ or 1 : cos ϑ.

Likewise thickness of wedge at $a_{,}$ is to that at $a_{,,,}$ as 1 : cos ϑ.

Through $a_{,}$ and $a_{,}$ draw double ordinates o p and r s. These double ordinate are equal because they are equally distant from center C.

Per *Conic Sections*,

Chord o p : chord h t :: $B_{,}$: $B_{,,}$.

Chord r s : chord i f :: $B_{,}$: $B_{,,,}$.

Let α be the difference between a right angle and the angle C $a_{,}$ p or C $a_{,}$ s, also let b be the difference between a right angle and the angle C $a_{,,}$ t and $b_{,}$ that of a right angle and angle C $a_{,,,}$ f.

The differential width at $a_{,}$ corresponding to n l in Dia. 4 is to differential width at $a_{,,}$ corresponding to s a Dia. 4 as $A_{,}$ cos α : $A_{,,}$ cos b.

Also the differential width at $a_{,}$ is to that at $a_{,,,}$ as $A_{,}$ cos α : $A_{,,,}$ cos $b_{,}$

The product then of thickness at $a_{,}$ into length op into width at $a_{,}$ is to that of thickness at $a_{,,}$ into length h t into width at $a_{,,}$

$$\text{As} \left\{ \begin{array}{ccc} 1 & : & \cos \vartheta \\ B_{,} & : & B_{,,} \\ A_{,} \cos \alpha & : & A_{,,} \cos b \end{array} \right\} :: A_{,}B_{,} \cos \alpha : A_{,,}B_{,,} \cos \vartheta \cos b :: 1 : \cos \vartheta.$$

Because $A_{,}B_{,}$ cos a equals $A_{,,}B_{,,}$ cos b the last ratio above is true.

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*These double ordinates and line P C should intersect at d.

Likewise the product of the thickness at $a_{,}$ into length r s into width at $a_{,}$ is to that of the thickness at $a_{,,,}$ into length i f into width at $a_{,,,}$.

$$\text{As} \begin{Bmatrix} B_{,} & : & B_{,,,} \\ 1 & : & \cos \vartheta \\ A_{,} \cos \alpha & : & A_{,,,} \cos b_{,} \end{Bmatrix} :: A_{,}B_{,} \cos \alpha : A_{,,,}B_{,,,} \cos b_{,} \cos \vartheta :: 1 : \cos \vartheta.$$

Mass-factor then at $a_{,}$ is to mass-factor at $a_{,,}$ or $a_{,,,}$ as $1 : \cos \vartheta$.

If in Diagram 7 conjugate diameters $A_{,}$ $A_{,}$ and $B_{,}$ $B_{,}$ were at right angles the chord element of mass and the wedge mass would be $\cos^2 \alpha_{,}$ to unity greater. Regardless of the law of variations of the angle $\alpha_{,}$ from wedge to wedge if we assume a homogenous solid made up of elliptic wedges having a common edge length of $B_{,}$ $B_{,}$, and limited in width by an ellipse with principal semi-axis A and $A_{,}$ having its plane in center C and at right angles to diameter $B_{,}$ $B_{,}$, then we have a volume that can be divided into infinitesimal wedges of equal masses in accordance with Art. 14. If the ellipsoid be divided into wedges having the same angular thicknesses as those of the assumed solid, then the mass of any wedge of the ellipsoid is to the mass of the corresponding wedge of the assumed solid as the square of the cosine of the α angle ($\cos^2 \alpha_{,}$) to unity. In the assumed solid let m represent the mass of the chord element, m that of the wedge and M, the mass of the whole solid; then in the ellipsoid $m \cos^2 \alpha_{,}$ is the mass of the chord element, m $\cos^2 \alpha_{,}$ that of the wedge. Let M be the mass of the ellipsoid.

Draw k $b_{,,}$ and j $b_{,,,}$ parallel to diameter $B_{,}$ $B_{,}$. As it was proven that $a_{,,}d$ equals $a_{,} \cos \vartheta$ so, by similar construction of diagram with radius of circle $a_{,}$ C, with a point $P_{,}$ in extension of diameter $A_{,}$ A' and with points of tangency corresponding to $a_{,,}$ and $a_{,,,}$ at $b_{,,}$ and $b_{,,,}$, it can be proven that k $b_{,,}$ and j $b_{,,,}$ each equals $b_{,} \cos \vartheta$.

By construction angle $Cb_{,,}$ k equals angle $a_{,,}$ P C, and $Cb_{,,,}$ j equals $a_{,,,}$ PC. Angle $b_{,,}$ k C and $b_{,,,}$ j C each varies from a right angle by the angle α. Let angle $a_{,,}$ P C be represented by $\vartheta + u$, and $a_{,,,}$ P C by $\vartheta - v$,

$$a_{,,} P = \frac{D \sin a_{,,} C P.}{\cos b}$$

From $a_{,,}$ conceive a perpendicular drawn to diameter $B_{,}$ $B_{,}$. In construction then we have a right angled triangle with hypothenuse $Ca_{,,}$ or $a_{,,}$ and with perpendicular equal to $a_{,} \cos \vartheta \cos \alpha$, in which

$$\sin a_{,,} C P = \frac{a' \cos \vartheta \cos \alpha}{a_{,,}} = \frac{A_{,} \cos \vartheta \cos \alpha}{A_{,,}}$$

$$a_{,,} P = \frac{D A' \cos \vartheta \cos \alpha}{A_{,,} \cos b}.$$

Likewise,

$$A_{,,,} P = \frac{D A_{,} \cos \vartheta \cos \alpha}{A_{,,,} \cos b_{,}}$$

Draw line P c making an angle $(\alpha \pm z)$ with P C, and let P c be the resultant direction of attraction for the two opposite chord elements. Draw line v C u making angle u C k or v C w equal to angle z; and draw lines

$b_{,,,}$ v and $b_{,,}$ z parallel to Pc. Then right angled triangle $b_{,,,}$ v C has angle C $b_{,,,}$ v equal to $\vartheta - v + (\alpha \pm z)$; and right angled triangle $b_{,,}$ z C has angle C $b_{,,}$ z equal to $\vartheta + u - (\alpha \pm z)$. Produce line $b_{,,}$ k to u, $b_{,,}$ z u is a right angled triangle. In triangle u C k angle C k u equals $90° + \alpha$, angle k C u equals z and C u k equals $90° - (\alpha \pm z)$.

$$\text{Side u k} = \frac{A_{,} \sin \vartheta \sin z}{\cos (\alpha \pm z)}$$

$$b_{,,} u = B_{,} \cos \vartheta + \frac{A_{,} \sin \vartheta \sin z}{\cos (\alpha \pm z)}$$

$$b_{,,} z = B_{,} \cos \vartheta \cos (\alpha \pm z) + A_{,} \sin \vartheta \sin z.$$

Likewise,

$$b_{,,,} v = B_{,} \cos \vartheta \cos (\alpha \pm z) - A_{,} \sin \vartheta \sin z.$$

In triangle $b_{,,}$ z C,

$$\cos [\vartheta + u - (\alpha \pm z)] = \frac{B_{,} \cos \vartheta \cos (\alpha \pm z) + A_{,} \sin \vartheta \sin z}{B_{,,}}$$

In triangle $b_{,,,}$ v C,

$$\cos [\vartheta - v + (\alpha \pm z)] = \frac{B_{,} \cos \vartheta \cos (\alpha \pm z) - A_{,} \sin \vartheta \sin z}{B_{,,,}}.$$

Let $E^2 = \frac{A_{,}^2 - B_{,}^2}{B_{,}^2}$

$$A_{,} = B_{,} \sqrt{1 + E^2}$$

$$\cos [\vartheta + u - (\alpha + z)] = \frac{B_{,} \cos \vartheta [\cos (\alpha \pm z) + \sqrt{1 + E^2} \tan \vartheta \sin z}{B_{,,}}$$

Let $l = \cos (\alpha \pm z)$, and $n = \sqrt{1 + E^2} \tan \vartheta \sin z$.

For mass ($m \cos \vartheta \cos^2 \alpha$) at $a_{,,}$ in direction Pc on particle P.

$$\text{Attraction} = \frac{m \cos^2 \alpha \; A_{,,}^2 \; B_{,} \cos^2 b \cos^2 \vartheta \; (l+n)}{D^2 \; A_{,}^2 \; B_{,,} \cos^2 \vartheta \cos^2 \alpha} = \frac{m \; A_{,,}^2 \; B_{,} \cos^2 b \, (l+n)}{D^2 A_{,}^2 B_{,,}}$$

$$A_{,,}^2 = \frac{A_{,}^2 \; B_{,}^2 \cos^2 \alpha}{B_{,,}^2 \cos^2 b}.$$

$$\text{Att., etc., then} = \frac{m \; B_{,}^3 \, (l+n) \cos^2 \alpha}{D^2 \; B_{,,}^3}.$$

Likewise for mass ($m \cos \vartheta \cos^2 \alpha$) at $a_{,,,}$ in direction Pc on particle P

$$\text{Att.} = \frac{m \; B_{,}^3 \, (l - n) \cos^2 \alpha}{D^2 \; B^3_{,,,}}$$

Draw C X perpendicular to $b_{,,}$ u, and draw a line from C perpendicular to $b_{,,,}$ j produced. In right angled triangle $b_{,,}$ X C, or in a right angled triangle similar having hypothenuse $B_{,,}$ C instead of $b_{,,}$ C,

Side for $C X = A_{,} \sin \vartheta \cos \alpha$.

Side for $b_{,,} X = B_{,} \cos \vartheta - A_{,} \sin \vartheta \sin \alpha$.

Hyp. $B_{,,}^2 = B_,^2 \cos^2 \vartheta + A_,^2 \sin^2 \vartheta \sin^2 \alpha + A_,^2 \sin^2 \vartheta \cos^2 \alpha - 2 A_, B_, \sin \vartheta \cos \vartheta \sin \alpha.$

$$= B_,^2 \left[1 + E^2 \sin^2 \vartheta - 2 \sqrt{1+E^2} \sin \vartheta \cos \vartheta \sin \alpha \right]$$

Likewise,

$$B_{,,,}^2 = B_,^2 [1 + E_,^2 \sin^2 \vartheta + 2\sqrt{1+E^2} \sin \vartheta \cos \vartheta \sin \alpha].$$

Let $s = E^2 \sin^2 \vartheta$, and $t = 2\sqrt{1+E^2} \sin \vartheta \cos \vartheta \sin \alpha$. By substitution and reduction.

$$\text{Att. etc., at } a_{,,} = \frac{m\,(1+n)\cos^2 \alpha}{D^2 [1 + (s - t)]^{\frac{3}{2}}}$$

$$\text{Att. etc., at } a_{,,,} = \frac{m\,(1-n)\cos^2 \alpha}{D^2 [1 + (s+t)]^{\frac{3}{2}}}$$

$$\frac{1+n}{[1+(s-t)]^{\frac{3}{2}}} = (1+n)[1 - \tfrac{3}{2}(s-t) + \frac{3.5}{2.4}(s-t)^2 - \text{etc}].$$

$$= (1+n)(1 - \tfrac{3}{2} s + \tfrac{3}{2} t + {}_{,,}).$$

For mass at $a_{,,}$ in direction pc on p.

$$\text{Att.} = \frac{m\,(1+n)\cos^2 \alpha}{D^2} (1 - \tfrac{3}{2} s \pm \tfrac{3}{2} t + {}_{,,}).$$

For mass at $a_{,,,}$ etc.

$$\text{Att.} = \frac{m\,(1-n)\cos^2 \alpha}{D^2} (1 - \tfrac{3}{2} s - \tfrac{3}{2} t + {}_{,,}).$$

Multiply the first series by (1+n) and the second by (1—n) and divide the sum of the results by two and we get

$$\text{Average Att.} = \frac{m \cos^2 \alpha}{D^2} (1 - \frac{3}{2} ls + \frac{3}{2} nt + \frac{3.5}{2.4} ls^2 + \frac{3.5}{2.4} lt^2 - \frac{3.5}{4} nst - {}_{,,}).$$

$$l = \cos(\alpha \pm z) = 1 - \tfrac{1}{2} \sin^2(\alpha \pm z) - \frac{1}{2.4} \sin^4(\alpha \pm z) - \text{etc}.$$

Replacing the values of l, s, n and t,

$$(a.)\ \text{Att.} = \frac{m \cos^2 \alpha}{D^2} \Big[1 - \frac{3}{2} E^2 \sin^2 \vartheta + \frac{3.5}{2.4} E^4 \sin^4 \vartheta + \frac{3.5}{2} \sin^2 \vartheta \sin^2 \alpha - \frac{3.5}{2} \sin^4 \vartheta \sin^2 a \pm 3 \sin^2 \vartheta \sin \alpha \sin z - \frac{1}{2} \sin^4(\alpha \pm z) - \frac{3.4.5.}{2.5.7.} E^6 \sin^6 \vartheta + {}_{,,} \Big].$$

Let (a+y) be the angle that line PC makes with the resultant direction of attraction for the two opposite wedges, then any two corresponding opposite chord elements contribute in the attraction of the two opposite wedges.

$$(b.)\ \text{Att.} = \frac{m \cos^2 \alpha}{D^2} \Big[1 - \frac{3}{2} E^2 \sin^2 \vartheta + \frac{3.5}{2.4} E^4 \sin^4 \vartheta + \frac{3.5}{2} \sin^2 \vartheta \sin^2 \alpha - \frac{3.5}{2} \sin^4 \vartheta \sin^2 \alpha \pm 3 \sin^2 \vartheta \sin \alpha \sin y - \frac{1}{2} \sin^2(a \pm y) - \frac{3.5.7}{2.4.6} E^6 \sin^6 \vartheta + {}_{,,} \Big]$$

In the above expression (b), for the two opposite wedges, angles α and $(\alpha \pm y)$ as well as eccentricity E are constant quantities. In accordance then with the expedient of Art. 12 for summation, an expression for the attraction of the two opposite infinitesimal wedges on particle P is found by putting

$$\text{Sin}^2 \vartheta = \frac{2}{5} n^2.$$

$$\text{Sin}^4 \vartheta = \frac{2.4}{5.7} n^4.$$

$$\text{Sin}^6 \vartheta = \frac{2.4.6}{5.7.9} n^6. \quad \text{Etc., for higher power .}$$

For the two opposite wedges in the plane of the principal axes of the ellipsoid on particle P,

$$\text{Att.} = \frac{m \cos^2 \alpha}{D^2} \left[1 - \frac{3}{5} n^2 E^2 + \frac{3}{7} n^4 E^4 + 3 n^2 \sin^2 \alpha - \frac{12}{7} n^4 \sin^2 \alpha \pm \frac{6}{5} n^2 \right.$$

$$\left. \sin \alpha \sin y - \frac{1}{2} \sin^2 (\alpha \pm y) - \frac{3}{9} n^6 E^6 + \text{"} \right]$$

In any two opposite wedges let $E_,$ represent the excentricity and angle $(\alpha_, + y_,)$, the direction of the resultant, then for any two opposite wedges:

$$\text{Att} = \frac{m \cos^2 \alpha_,}{D^2} \left[1 - \frac{3}{5} n^2 E_,^2 + \text{"} \right]$$

$$\text{(c)} \quad \text{Att} = \frac{m}{D^2} \left[1 - \frac{3}{5} n^2 E_,^2 + \frac{3}{7} n^4 E_,^4 - \sin^2 \alpha_, + 3 n^2 \sin^2 \alpha_, - \frac{12}{7} \right.$$

$$\left. n^4 \sin^2 a_, \pm \frac{6}{5} n^2 \sin a_, \sin y_, - \frac{1}{2} \sin^2 (\alpha \pm y) - \frac{3}{9} n^6 E_,^6 + \text{"} \right]$$

19. To find an expression for angle α, and for the eccentricity $E_,^2$ of any wedge.

Let O be the elliptic angle for the ellipse having A and B for semi major and semi minor axes, and let ξ be the elliptic angle for the ellipse having A and A, for semi major and semi minor axes; also let $a_,$ be any semi diameter of the ellipse having A and A, for semi major and semi minor axes, and let b be the semi minor axis of the ellipse having A for semi major axis and $a_,$ and B, for semi conjugate diameters.

For any infinitesimal wedge of the ellipsoid having its edge in diameter B, B, ,

$$\text{Sin}^2 \alpha_, = \frac{a_,^2 B_,^2 - A^2 b^2}{a_,^2 B_,^2}$$

$$B_,^2 = B^2 + (A^2 - B^2) \sin^2 O.$$

$$a_,^2 = A^2 - (A^2 - B^2) \sin^2 O \sin^2 \xi.$$

$$a_,^2 + B_,^2 = A^2 + B^2 + (A^2 - B^2) \sin^2 O \cos^2 \xi.$$

Per *Conic Sections*,

$A^2 + b^2 = a_{,}^2 + B_{,}^2$.

Therefore $b^2 = B^2 + (A^2 - B^2) \sin^2 O \cos^2 \xi$.

$a_{,}^2 B_{,}^2 - A^2 b^2 = (A^2 - B^2)^2 \sin^2 O \cos^2 O \sin^2 \xi$.

$$\text{Sin}^2\ \alpha_{,} = \frac{(A^2-B^2)^2 \sin^2 O \cos^2 O \sin^2 \xi}{a_{,}^2\ B_{,}^2} = \frac{E^4 \sin^2 O \cos^2 O \sin^2 \xi}{(1-E^2 \sin^2 O \sin^2 \xi)(1-E^2 \cos^2 O)}.$$

$\text{Sin}^2\ \alpha_{,} = E^4 \sin^2 O \cos^2 O \sin^2 \xi + E^6 \sin^2 O \cos^4 O \sin^2 \xi + \ldots$

$\text{Sin}\ \alpha_{,} = E^2 \sin O \cos O \sin \xi + \frac{1}{2} E^4 \sin O \cos^3 O \sin \xi + \frac{1}{2} E^4 \sin^3 O \cos O \sin^2 \xi + \frac{1}{4} E^6 \sin^3 O \cos^3 O \sin^3 \xi - \ldots$.

$$E_{,}^2 = \frac{a_{,}^2 - B_{,}^2}{B_{,}^2} = E^2 \cos^2 O - E^2 \sin^2 O \sin^2 \xi + E^4 \cos^4 O - E^4 \sin^2 O \cos^2 O \sin^2 \xi + E^6 \cos^6 O - \ldots$$

$E_{,}^4 = E^4 \cos^4 O - 2\ E^4 \sin^2 O \cos^2 O \sin^2 \xi + E^4 \sin^4 O \sin^4 \xi + 2\ E^6 \cos^6 O - \ldots$.

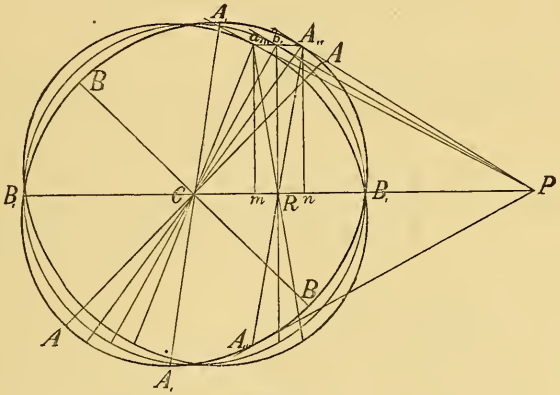

Diagram 8.

To find an expression for angle $(\alpha_{,} + y_{,})$ for any two opposite wedges.

Diagram 8 is constructed in accordance with diagram 7, having lower part laid over so that point $A_{,,,}$ becomes $a_{,,,}$. $A_{,,}$ n and $a_{,,,}$ m are drawn perpendicular to P C. Angle $a_{,,,}$ R $A_{,,}$ equals 2 α, C $b_{,}$ R or $b_{,}$ P C equals ϑ, $A_{,,}$ P R equals $(\vartheta + \varkappa)$ and $a_{,,}$ P R equals $(\vartheta - \upsilon)$.

In triangle $A_{,,}$ $Pa_{,,}$,

(a). $\sin\ A_{,,}\ Pa_{,,}$ or $\sin(\varkappa + \upsilon) = \frac{2 \sin \alpha}{\cos \alpha} \sin(\vartheta + \varkappa) \sin(\vartheta - \upsilon)$.

$Pb_{,} = D \cos \vartheta$; $PR = D \cos^2 \vartheta$; and $b_{,} R = D \sin \vartheta \cos \vartheta$.

$A_{,,} R = a_{,,,} R = \frac{A_{,}}{B_{,}} D \sin \vartheta \cos \vartheta = \sqrt{1+E^2}\ D \sin \vartheta \cos \vartheta$

$A_{,,} n = a_{,,,} m = \sqrt{1+E^2}\ D \sin \vartheta \cos \vartheta \cos \alpha$,

$$R\,n = R\,m = \sqrt{1+E^2}\ D \sin \vartheta \cos \vartheta \sin \alpha$$

$$P\,n = D \cos \vartheta \left(\cos \vartheta - \sqrt{1+E^2} \sin \vartheta \sin \alpha \right)$$

$$Pm = D \cos \vartheta \left(\cos \vartheta + \sqrt{1+E^2} \sin \vartheta \sin \alpha \right)$$

$$A_{''}P = \sqrt{\overline{Pn}^2 + \overline{A_{''}n}^2} = D \cos \vartheta \left[1+E^2 \sin^2 \vartheta - 2\sqrt{1+E^2} \sin\vartheta\cos\vartheta\sin\alpha \right]^{\frac{1}{2}}$$

$$A_{'''}P = \sqrt{\overline{Pm}^2 + \overline{a_{'''}m}^2} = D \cos \vartheta \left[1+E^2 \sin^2 \vartheta + 2\sqrt{1+E^2} \sin\vartheta\cos\vartheta\sin\alpha \right]^{\frac{1}{2}}$$

$$\text{Sin } (\vartheta+u) = \frac{A_{''}n}{A_{''}P} = \frac{\sqrt{1+E^2}\ \sin\vartheta\cos\alpha}{\left[1+E^2 \sin^2\vartheta - 2\,(1+E^2)^{\frac{1}{2}} \sin\vartheta\cos\vartheta\sin\alpha \right]^{\frac{1}{2}}}$$

$$\text{Sin } (\vartheta-v) = \frac{a_{'''}m}{a_{'''}P} = \frac{\sqrt{1+E^2}\ \sin\vartheta\cos}{\left[1+E^2 \sin^2\vartheta + 2\,(1+E^2)^{\frac{1}{2}} \sin\vartheta\cos\vartheta\sin\alpha \right]^{\frac{1}{2}}}$$

$$\text{Sin } (\vartheta+u) \sin (\vartheta-v) = \frac{\left(1+E^2\right) \sin^2\vartheta\cos^2\alpha}{\left[(1+E^2 \sin^2\vartheta)^2 - 4\ (1+E^2)\ \sin^2\vartheta\cos^2\vartheta\sin^2\alpha \right]^{\frac{1}{2}}}$$

Expand and reduce this value for sin $(\vartheta+u)$ sin $(\vartheta-v)$, and substitute the result in expression (a) of this Art.,

$$\text{Sin}(u+v) = 2 \sin\alpha \cos\alpha \,(\sin^2\vartheta + E^2 \sin^2\vartheta - E^2 \sin^4\vartheta - E^4 \sin^4\vartheta + E^4 \sin^6\vartheta + 2 \sin^4 \vartheta \sin^2 \alpha - 2 \sin^6 \vartheta \sin^2\alpha + E^6 \sin^6\vartheta - _{''}).$$

$$\text{Sin } (u+v) = 2 \sin\alpha \,(\sin^2\vartheta + E^2 \sin^2 \vartheta - E^2 \sin^4\vartheta - E^4 \sin^4\vartheta + E^4 \sin^6\vartheta - \tfrac{1}{2} \sin^2\vartheta \sin^2\alpha + 2 \sin^4\vartheta \sin^2 \alpha - 2 \sin^6\vartheta \sin^2\alpha + E^6 \sin^6\vartheta - _{''})$$

$$\tan (u+v) = 2 \sin \alpha \,(\sin^2 \vartheta + E^2 \sin^2 \vartheta - E^2 \sin^4 \vartheta - E^4 \sin^4 \vartheta + E^4 \sin^6 \vartheta - \tfrac{1}{2} \sin^2 \vartheta \sin^2 \alpha + 2 \sin^4 \vartheta \sin^2 \alpha + E^6 \sin^6 \vartheta - ''').$$

The difference $(4 \sin^6 \vartheta \sin^3 \alpha)$ between tan $u+v)$ and sin $(u+v)$ is of the order of the sixth power of eccentricity, therefore to the sixth power of eccentricity, per this method of development, the sine, the arc and the tangent of the angle $(u+v)$ are of the same length.

Diagram 9 is so constructed that triangles $A_{''}$ P R and $A_{'''}$ P R are equal to triangles like lettered in Dia. 8. In line P $A_{'''}$ take P B equal to P $A_{''}$, and let it be represented by unity. Produce P $A_{''}$ to D, making P D equal to P $A_{'''}$, and let it be represented by $(1+a)$. Produce P D to F making P F equal to $(1+a)^2$. Complete parallograms P $A_{''}$ C B, P D E B and P F G B, and draw diagonals P C, P E and P G.

By construction angles R P C and E P C are equal, and either of these angles is equal to half the difference of the angles P E D and E P D or E P B. Angle C P G is also half the difference of angles P G F and G P F or G P B. Diagonal P G is the direction of the resultant of the two forces represented by the lines 1 and $(1+a)^2$.

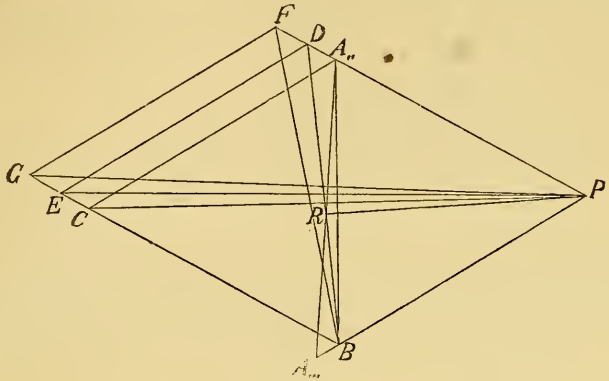

Diagram 9.

Angle R P E is equal to angle (u+v).

In triangle P E D,

$$\tan\frac{P\,E\,D+E\,P\,D}{2}=\tan C\,P\,E\,\frac{2+a}{a}.$$

In triangle P G F,

$$\tan\frac{P\,G\,F+G\,P\,F}{2}=\tan\,C\,P\,G\,\frac{2+2\,a+a^2}{2\,a+a^2}$$

The half sum of angles PED and EPD is equal to the half sum of angles PGF and GPF, therefore

$$\tan\,CPE\,\frac{2+a}{a}\;=\;\tan CPG\;\frac{2+2a+a^2}{2a+a^2}$$

$$\frac{\tan CPG}{\tan CPE}\;=\;2-\tfrac{1}{2}\,a^2+\tfrac{1}{2}\,a^3-\tfrac{1}{4}\,a^4+_{"}$$

From values of $A_{"}P$ and $a_{"}P$ already developed in this Art.,

$$a\;=\;2\sqrt{1+E^2}\sin\vartheta\cos\vartheta\sin\alpha-2\,E^2\sqrt{1+E^2}\,\sin^3\vartheta\cos\vartheta\sin\alpha\;+$$
$$(1+E^2)^{\frac{3}{2}}\sin^3\vartheta\cos^3\sin^3\vartheta\,\alpha+_{"}$$

$$a^2\;=\;4\sin^2\vartheta\cos^2\vartheta\sin^2\alpha+_{"}$$

The angle CPE is one half of angle RPE or $\frac{1}{2}$ (u+v).

$$\tan\frac{u+v}{2}\;=\;\frac{1-\cos(u+v)}{\sin(u+v)}\;=\;\frac{1}{2}\,\sin\,(u+v)+\frac{1}{2.4}\sin^3(u+v)+\text{etc.}$$

$$\tan CPG=2(1-\sin^2\vartheta\cos^2\vartheta\sin^2\alpha+_{"})\tan\,\frac{u+v}{2}$$

$$\tan(\alpha \pm z) = \tan\left(\text{CPG} + \frac{u+v}{2}\right) = \frac{\tan \text{CPG} + \tan \frac{u+v}{2}}{1 - \tan \text{CPG} \tan \frac{u+v}{2}}$$

$$\sin(\alpha \pm z) = \frac{\tan(\alpha \pm z)}{\sqrt{1+\tan^2(\alpha \pm z)}}$$

As the chord elements of attraction from wedge to wedge vary in mass as $m \cos^2 \alpha$ the above expression for $\sin(\alpha \pm z)$ must be multiplied by $m \cos^2 \alpha$. Thus modified and expanded,

$$\sin(\alpha \pm z) = 3m \cos^2 \alpha \sin \alpha (\sin^2 \vartheta + E^2 \sin^2 \vartheta - \text{"}).$$

$$\sin(\alpha \pm z) = 3m \sin \alpha (\sin^2 \vartheta + E^2 \sin^2 \vartheta - E^2 \sin^4 \vartheta - E^4 \sin^4 \vartheta + E^4 \sin^6 \vartheta - \frac{3}{2} \sin^2 \vartheta \sin^2 \alpha + \frac{4}{3} \sin^4 \vartheta \sin^2 \alpha - \frac{23}{6} \sin^6 \vartheta \sin^2 \alpha + E^6 \sin^6 \vartheta - \text{"})$$

The letters in the above expression are for the plane of the principal axes. For any plane substitute $\alpha_,$, $E_,$, m, and $y_,$ for z. As $\alpha_,$ and $E_,$ are constant quantities for any two opposite wedges, summation of chord elements for opposite wedges can be made per expedient of Art. 12, by putting;

$$\sin^2 \vartheta = \frac{2}{5} n^2.$$

$$\sin^4 \vartheta = \frac{2.4}{5.7} n^4, \text{ etc., for higher powers.}$$

$$\sin(\alpha_, \pm y_,) = \frac{6}{5} m \sin \alpha_, n^2 \left(1 + E_,^2 - \frac{4}{7} E_,^2 n^2 - \frac{4}{7} E_,^4 n^2 + \frac{4.6}{7.9} E_,^4 n^4 - \frac{3}{2} \sin^2 \alpha_, + \frac{16}{21} n^2 \sin^2 \alpha_, - \frac{92}{63} n^4 \sin^2 \alpha_, + \frac{4.6}{7.9} E_,^6 - \text{"}\right)$$

Substitute in the above expression the values given for $\sin \alpha_,$ and eccentricity $(E_,)$ in Art. 19.

$$\text{(b.)} \quad \sin(\alpha_, \pm y_,) = \frac{6}{5} \frac{m n^2 E^2 \sin O \cos O \sin \xi}{[(1 - E^2 \sin^2 O \sin^2 \xi)(1 - E^2 \cos^2 O)]^{\frac{1}{2}}}$$

$$[1 + E^2 \cos^2 O \left(1 - \tfrac{4}{7} n^2\right) - E^2 \sin^2 O \sin^2 \xi \left(1 - \tfrac{4}{7} n^2\right) + E^4 \cos^4 O \left(1 - \tfrac{8}{7} n^2 + \tfrac{8}{21} n^4\right) - E^4 \sin^2 O \cos^2 O \sin^2 \xi \left(\tfrac{5}{2} - \tfrac{52}{21} n^2 + \tfrac{20}{9} n^4\right) - \tfrac{4}{7} n^2 E^4 \sin^4 O \sin^4 \xi \left(1 - \tfrac{8}{8} n^2\right) + \text{"}].$$

21. To find the resultant direction of attraction for the whole Ellipsoid.

For any two opposite wedges there are two corresponding opposite wedges in the adjacent quarters of the Ellipsoid. The resultant for these four wedges is found by multiplying the expression for the resultant of either of the two opposite wedges by the cosine of the angle [90° minus the alpha elliptic angle $(\xi - b)$], or the sine of the alpha elliptic angle $(\xi - b)$. Let $(\alpha_, \pm y_,)$ be the angle for the resultant of the four wedges.

$$\sin(\xi - b) = \frac{A_, \sin \xi}{a_,} = \frac{\sin \xi (1 - E^2 \sin^2 O)^{\frac{1}{2}}}{(1 - E^2 \sin^2 O \sin^2 \xi)^{\frac{1}{2}}}.$$

Multiply this value for sin (ξ—b) by expression (b) Art. 20, then the expression for the resultant of the four wedges is,

$\sin(a_{,} \pm y_{,,}) = \frac{6}{5}\, m\, n^2\, E^2 \sin O \cos O\, [(1+\frac{3}{2} E^2 - 2 E^2 \sin^2 O - \frac{4}{7} n^2 E^2 + \frac{4}{7} n^2 E^2 \sin^2 O) \sin^2 \xi + \frac{4}{7} n^2 E^2 \sin^2 O \sin^4 \xi \pm_{,,}]$.

If the attraction of the pairs of wedges were equal, each to each, then per Art. 15, the resultant of attraction for the whole ellipsoid would be found by putting,

$$\sin^2 \xi = \tfrac{1}{2}$$

$$\sin^4 \xi = \frac{3}{2.4}, \text{ etc. for higher powers.}$$

Let ($\alpha \pm$ w') be the approximate angle for the resultant so found.

(a) $\sin(\alpha \pm w') = \frac{3}{5} Mn^2 E^2 \sin 0 \cos 0_{,,}[1 + E^2(\frac{3}{2} - 2 \sin^2 O - \frac{4}{7} n^2 + n^2 \sin^2 O) + E^4(") +_{,,}]$.

To correct this result let (s) be the angle that the resultant of any four wedges having the angle ξ greater than 45°, makes with the resultant of the four wedges so taken that the square of the sine of angle ξ in first plus the square of the sine of angle ξ in the second shall equal unity. The correction for any such group of eight wedges is the difference of a certain two angles the sum of which is a certain angle (s). Let p and r be these angles. Expressions for the sum and difference of the resultant attractions for the two four wedge groups are obtainable from expression (c) Art. 18. By a well known trigonometrical method the expression for the tangent of the half difference of the two angles p and r is:

$$\tan \frac{p-r}{2} = \frac{9}{50} MN^4 E^4 \sin^3 O \cos O\, [(1+E^2(_{,,})\, (2 \sin^2 \xi - 1)^2 \pm_{,,}].$$

$$(2 \sin^2 \xi - 1)^2 = 1 - 4 \sin^2 \xi \cos^2 \xi.$$

The expression $[\sin^2 a \cos^2 a + \sin^2 (45° - a) \cos^2 (45° - a] = \frac{1}{4}$, from well-known trigonometrical fromulæ, proves that the value of $\sin^2 \xi \cos^2 \xi$ for any and every group of eight wedges or for the average of all groups composing the ellepsoid is $\frac{1}{8}$, therefore for the whole ellipsoid the correction becomes:

$$\tan \frac{p-r}{2} = \frac{9}{100} Mn^4 E^4 \sin^3 O \cos O\, [(1+E^2(_{,,}) +_{,,}].$$

$$\sin \frac{p-r}{2} = \frac{9}{100} Mn^4 E^4 \sin^3 O \cos O\, [1+E^2(_{,,}) +"].$$

This correction united additionally, as the conditions require it, to expression (a) of this Art. gives:

$\sin(\alpha - w) = \frac{3}{5} Mn^2 E^2 \sin O \cos O\, [1 + E^2 (\frac{3}{2} - 2 \sin^2 O - \frac{4}{7} n^2 + \frac{2}{2}\frac{3}{0} n^2 \sin^2 O) + E^4(_{,,}) +_{,,}]$.

This method of correction gives an expression exactly true to the eighth power of eccentricity. Another order of correction, similar to the one treated, commences with the eighth power of ecentricity, but its effect is small when eccentricity is large, owing to the fact that each group of eight wedges to be combined in the next order of resultants, is so composed of wedges from different parts of the ellipsoid, that the attractions of all groups of eight are very nearly equal each to each.

$$M=\frac{M^*}{1-\sin^2 a_{,}}=\frac{M}{1-\frac{1}{2}E^4\sin^2 O\cos^2 O^2+''}$$

Substitute this value for M in the above expression for sin $(\alpha-W)$ and we get for the whole ellipsoid the angle that the direction of attraction makes with the direction from the attracted particle to the center of the ellipsoid.

$$\text{(b) } \sin(\alpha-W)=\frac{3}{5}M n^2 E^2\sin O\cos O\Big[1+E^2\frac{3}{(2}-2\sin^2 O-\frac{4}{7}n^2+\frac{23}{20}$$

$$n^2\sin^2 O)+E^4(_{''})+''\Big]$$

When the attracted particle is at the surface of the ellipsoid n becomes uni y and the expression is:

$$\text{(c) } \sin(\alpha-W)=\frac{3}{5}M E^2\sin O\cos O\Big[1+E^2\Big(\frac{13}{14}-\frac{17}{20}\sin^2 O\Big)+E^4(_{''})+_{''}\Big]$$

$$\sin(\alpha-W)=\frac{3}{5}M\sin O\cos O\Big[E^2+E^4\Big(\frac{13}{14}-\frac{17}{20}\sin^2 O\Big)+E^6(_{''})+_{''}\Big]$$

In the above, in order to get the term depending on E^4 exact. it is to be observed that M can be used for M, angle ξ, for $(\xi-b)$ and arc of angle α for sine or tangent, also so far as the expression is dependent on attraction (c) Art. 18 the terms E^4 and $\sin^2\alpha$ are not involved.

22. To find the attraction of an oblate ellipsoid on any outside particle.

By requisite substitution, expression (c) Art. 18 for two opposite wedges becomes:

$$\text{(a) } Att.=\frac{m}{D^2}(1-\frac{3}{5}n^2E^2\cos^2 O+\frac{3}{5}n^2E^2\sin^2 O\sin^2\xi-\frac{3}{5}n^2E^4\cos^4 O+\frac{3}{7}n^4E^4\cos^4 O$$

$$+\frac{3}{7}n^4E^4\sin^4 O\sin^4\xi-\frac{43}{25}E^4\sin^2 O\cos^2 O\sin^2\xi+\frac{12}{5}n^2E^4\sin^2 O\cos^2$$

$$O\sin^2\xi-\frac{198}{175}n^4E^4\sin^2 O\cos^2 O\sin^2\xi+_{''}).$$

Expression (b) Art. 20 modified for tangent and reduced gives:

$$\tan(\alpha_{,}+y_{,})=\frac{6}{5}n^2E^2\sin O\cos O\sin\xi(1+\frac{3}{2}E^2\cos^2 O-\frac{4}{7}n^2E^2\cos^2 O-\frac{1}{2}E^2\sin^2 O$$

$$\sin^2\xi+\frac{4}{7}n^2E^2\sin^2 O\sin^2\xi+_{''}).$$

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* The Italic M represents greater mass than the Roman in this investigation.

Expression (b) Art. 21 gives:

$$\tan(\alpha - w) = \frac{3}{5} n^2E^2 \sin O \cos O \left(1+\frac{3}{2}E^2 - 2E^2\sin^2 O - \frac{4}{7}n^2E^2 + \frac{23}{20}n^2E^2 \sin^2 O + {}_{n}\right).$$

$(\alpha_{,} \pm y_{,})$ is the angle that D* makes with the resultant of any two opposite wedges. and $(\upsilon - w)$ is the angle that D also makes with the resultant for the whole ellipsoid. The tangents of the angles having the same radius (D) are in the same plane perpendicular to D. To determine the distance of the resultant of any two opposite wedges from the resultant of the whole ellipsoid, these tangents may represent the adjacent side of a triangle having the included angle $[90° - (\xi - b]$. Let the tangent of angle $(\alpha_{,} \pm y_{,})$ be (b) and that of $(\alpha - w)$ be (a), then the third side (d) is the distance of the resultant, in tangent of angle. of any two opposite wedges from that of the whole ellipsoid.

Tugonometry gives:

$$d = \sqrt{a^2 - b^2 - 2ab\cos[90° - (\xi - b)]} = \sqrt{a^2 - b^2 - 2ab\sin(\xi - b)}.$$

$$d = \frac{3}{5}n^2E^2 \sin O \cos O\left(1+\frac{3}{2}E^2 - 2E^2\sin^2 O - \frac{4}{7}n^2E^2 + \frac{23}{20}n^2E^2\sin^2 O + 2E^2 \sin^2 O \sin^2\xi - \frac{81}{70}n^2E^2\sin^2 O\sin^2\xi - 2E^2\sin^2 O\sin^4\xi + \frac{8}{7}n^2E^2\sin^2 O\sin^4\xi + {}_{,}\right).$$

Let $c^2 = 1 + \tan^2(\alpha - w)$.

$f = 1 + \tan^2(\alpha_{,} - y_{,})$.

Let r be the angle that the resultant of any two opposite wedges makes with the resultant of the whole ellipsoid.

Trigonometry gives:

$$\cos r = \frac{c^2 + f^2 - d^2}{2cf}$$

$$\text{Cos } r = 1 - \tfrac{9}{50}n^4E^4\sin^2 O\cos^2 O\left(1+3E^2 - 4E^2\sin^2 O - \tfrac{8}{7}n^2E^2 + \tfrac{23}{20}n^2E^2\sin^2 O + 12E^2\sin^2\xi + 4E^2\sin^2 O\sin^2\xi - \tfrac{81}{35}n^2E^2\sin^2 O\sin^2\xi - 4E^2\sin^2 O\sin^4\xi + \tfrac{16}{7}n^2E^2\sin^2 O\sin^4\xi + {}_{n}\right).$$

Multiply expression (a) this Art. by the above value for cos r and the expression for the attraction of any two opposite wedges in the direction of the resultant for the whole ellipsoid becomes:

$$\text{Att.} = \frac{M}{D^2}\left(1 - \tfrac{3}{5}n^2E^2\cos^2 O + \tfrac{3}{5}n^2E^2\sin^2 O\sin^2\xi - \tfrac{3}{5}n^2E^4\cos^4 O - \tfrac{9}{50}n^4E^4\sin^2 O\cos^2 O + \tfrac{3}{7}n^4E^4\cos^4 O + \tfrac{3}{7}n^4E^4\sin^4 O\sin^4\xi - \tfrac{43}{25}E^4\sin^2 O\cos^2 O\sin^2\xi + \tfrac{12}{5}n^2E^4\sin^2 O\cos^2 O\sin^2\xi - \tfrac{198}{175}n^4E^4\sin^2 O\cos^2 O\sin^2\xi + {}_{n}\right).$$

For the whole ellipsoid per Art. 15

$\text{Sin}^2\xi = \frac{1}{2}$.

$\text{Sin}^4\xi = \frac{3}{2.4.}$ Etc., for higher powers.

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* Line D extends from attracted particle to center of ellipsoid.

The expression for the whole ellipsoid becomes:

$$\text{Att.} = \frac{M}{D^2}\left(1 - \tfrac{3}{5}\, n^2\, E^2 \cos^2 O + \tfrac{3}{10}\, n^2\, E^2 \sin^2 O - \text{"}\right).$$

$$M = \frac{M}{\cos^2 \alpha_{,}} = M\,(1 + \tfrac{1}{2}\, E^4 \sin^2 O \cos^2 O + \tfrac{1}{2}\, E^6 \sin^2 O \cos^4 O + \tfrac{3}{8}\, E^6 \sin^4 O \cos^2 O + \text{"}).$$

b. $$\text{Att.} = \frac{M}{D^2}\left(1 - \tfrac{3}{5}\, n^2\, E^2 \cos^2 O + \tfrac{3}{10}\, n^2\, E^2 \sin^2 O - \tfrac{3}{5}\, n^2\, E^4 \cos^4 O + \tfrac{3}{7}\, n^4\, E^4 \cos^4 O - \tfrac{3}{25}\, E^4 \sin^2 O \cos^2 O + \tfrac{6}{5}\, n^2\, E^4 \sin^2 O \cos^2 O + \tfrac{9}{56}\, n^4\, E^4 \sin^4 O - \tfrac{2}{3}\tfrac{6}{5}\tfrac{1}{0}\, n^4\, E^4 \sin^2 O \cos^2 O + \text{"}).$$

$$\text{Att.} = \frac{M}{D^2}\left[1 - \tfrac{3}{5}\, n^2\, E^2\,(1 - \tfrac{3}{2}\sin^2 O) - \tfrac{3}{5}\, E^4\,(n^2 - \tfrac{5}{7}\, n^4 + \tfrac{3}{5}\sin^2 O - \tfrac{3}{5}\sin^4 O - 4\, n^2 \sin^2 O + 3\, n^2 \sin^4 O + \tfrac{1}{7}\tfrac{8}{0}\tfrac{7}{0}\, n^4 \sin^2 O - \tfrac{8}{4}\tfrac{9}{0}\, n^4 \sin^4 O) + \text{"}\right]$$

23. To find the increase in attraction in passing on the surface of an oblate ellipsoid from the equator to the poles.

When the attracted particle is at the surface of the Ellipsoid n equals unity and D equals $B_{,}$, and expression (b) Art. 22 becomes

$$\text{Att} = \frac{M}{B^2}\,(1 - \tfrac{3}{5}\, E^2 \cos^2 O + \tfrac{3}{10}\, E^2 \sin^2 O - \text{"}).$$

$$B_{,}^2 = A^2\,(1 - E^2 \cos^2 O).$$

$$\text{Att} = \frac{M}{A^2}\left(1 + \tfrac{2}{5}\, E^2 \cos^2 O + \tfrac{3}{10}\, E^2 \sin^2 O + \tfrac{8}{35}\, E^4 \cos^4 O + \tfrac{9}{56}\, E^4 \sin^4 O + \frac{69}{175}\, E^4 \sin^2 O \cos^2 O + \text{"}\right)$$

(a) $$\text{Att} = \frac{M}{A^2}\left(1 + \tfrac{2}{5}\, E^2 - \tfrac{1}{10}\, E^2 \sin^2 O + \tfrac{8}{35}\, E^4 - \tfrac{11}{175}\, E^4 \sin^2 O - \tfrac{1}{200}\, E^4 \sin^4 O + \text{"}\right)$$

At the poles angle O becomes zero, and

(b) $$\text{Att} = \frac{M}{A^2}\left(1 + \frac{2}{5}\, E^2 + \frac{2.4}{5.7}\, E^4 + \text{etc}\right)$$

At the equator angle O becomes ninety degrees, and

(c) $$\text{Att} = \frac{M}{A^2}\left(1 + \frac{3}{10} E^2 + \frac{3.3}{7.2.4}\, E^4 + \frac{3.3.5}{9.2.4.6} E^6 + \text{etc.}\right)$$

Subtract expression (a) from (b) and the difference is,

$$\frac{M}{A^2}\left[\frac{1}{10}\, E^2 \sin^2 O + E^4 \sin^2 O \left(\frac{11}{175} + \frac{1}{200} \sin^2 O\right) + \text{"}\right].$$

$$= \frac{M}{A^2}\left[\frac{1}{5}\, h \sin^2 O + h^2 \sin^2 O \left(\frac{53}{350} + \frac{1}{50} \sin^2 O\right) + \text{"}\right].$$

The increase in attraction then from the equator to the poles varies as the square of the sine of the elliptic angle, exact for the second power of excentricity or first power of ellipticity and very nearly true to the sixth power of eccentricity or the third power of ellipticity.

VII.

The gravity and the Figure of a body, due to its Rotation and the attraction of its Component Particles.

First.—The oblate ellipsoid is the figure of equilibrium due to the rotation and attraction of the component particles of a fluid body.

Second.—The increase in gravity from the equator to the poles varies as the square of the sine of the elliptic angle, or the angle with vertex at center of figure, and not as the square of the sine of latitude.

24. To find the combined effect of attraction and rotation on any particle in the plane of the equator of an oblate ellipsoid.

Case 1st. When the velocity of rotation is just sufficient to counterbalance the attraction of the ellipsoid on the particle.

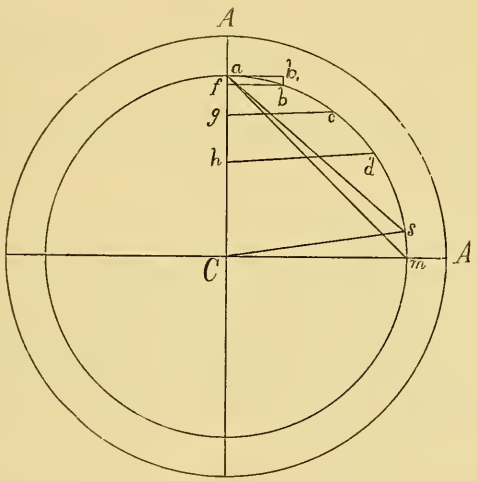

Diagram 10.

In Dia. 10 let a be the particle and let arc a b be the distance of rotation for an infinitesimal unite of time (t) or velocity of rotation. Let a f the versed sine of arc a b in direction A C represent the unite of attraction, also let f a in direction C A represent the repulsive effect of rotation. As attraction just counter-balances repulsion the particle must revolve in the circumference of a circle of radius a C. As attraction and repulsion act at a right angle to an infinitesimal portion of the circumference these forces can neither increase or diminish the velocity (v) of rotation.

Let a f, a g, a h, etc., to a C represent the attraction of the ellipsoid for one, two, three, etc., units of time acting on a particle with a constant force equal to the attraction of the ellipsoid at distance a C. On the circumference lay off arcs a b, b c, c d, etc., to s, each equal to a b; and con-

nect points f b, g c, h d, etc., to C s. By the law of the expedient of this demonstration the time required for particle a to revolve to s acted on by the combined forces is that required for a constant force equal to the attraction of the ellipsoid at distance a C, to move the particle over the distance a C. Let distance a C be represented by (a) and a f by (c). Per law of ultimate ratio tangent a $b_{,}$ arc a b and chord a b are equal each to each.

$$\text{Chord } \overline{a\,b}^2 = v^2 = 2\,a \times c. \quad 2\,a = \frac{v^2}{c}$$

$$\text{Chord of a quadrant, } \overline{a\,m}^2 = 2\,a^2 = \frac{a\,v^2}{c}.$$

Per law of *falling bodies:*

$$a = t^2\,c. \quad t = \frac{\sqrt{a}}{\sqrt{c}}$$

$$\overline{a\,m}^2 = v^2\,t^2. \quad a\,m = v\,t.$$

v t is the length of the arc a s, and a m is the chord of a quadrant. The time required for the particle to revolve over the arc a s is $\frac{\sqrt{a}}{\sqrt{c}}$. $\sqrt{2}$ is the length of the chord a m, when $2\,\pi$ is the length of a circumference The time (T) required for a complete revolution of the particle or the rotation of the ellipse is :

$$T = \frac{\pi\,\sqrt{2\,a}}{\sqrt{c}}. \qquad T^2 = \frac{2\,a\,\pi^2}{c}.$$

In case of a homogenious oblate ellipsoid, the mass inside of the layer having semi-major axis (a), varies as (a) cubed. The attraction, then, of the ellipsoid on particle (a) in the plane of the equator varies directly as distance (a). As the ellipsoid rotates as one mass the time of revolution of all component particles is the same, and all particles in the plane of the equator rotate without pressure.

Case 2d.—When the repulsion from rotation is not sufficient to counterbalance attraction.

It is evident from case 1st, without further investigation, that the loss of pressure for particle a varies inversely as the time squared of rotation of the ellipsoid to the time of rotation required squared for repulsion to counterbalance attraction.

Case 3d.—When the repulsion from rotation is greater than attraction.

In Dia. 11 let arc a $b_{,,}$ be the velocity of rotation for an infinitesimal unit of time. The initial impulse of rotation acting alone would throw particle (a) in direction of tangent to distance a $b_{,}$ equal to arc a $b_{,,}$. Let a f be the attraction for the first unit of time. D aw $b_{,,}$ f' perpendicular to a C, then a f' represents the force required acting in direction a C to make the particle revolve in a circle. The versed sine f' a in direction C a is the

repulsive effect from the rotation measured by the system of a circle. Draw f b perpendicular to a C, and from the initial point a, draw diagonals a b and a $b_{''}$. Under the hypothesis that no component particle excepting particle a, has freedom to change position in the ellipsoid, it is evident that this exceptional particle acted upon by the forces combined would be at the end of the first unit of time at b instead of at $b_{''}$ as it was in Case 1st.

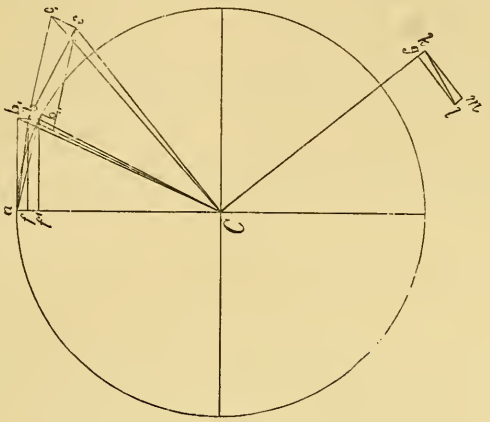

Diagram 11.

If during the second unit of time attraction did not act the particle would continue to move in direction a b to c' making distance b c' equal to a b. It is evident under the action of the forces combined at the end of the second unit of time, the particle would be found at some point c in in line c c' drawn parallel to b C. The position of the particle for the third or any unit of time in due order can likewise be determined.

Triangles C b c and Cbc^1 are equal from having same base Cb and equal altitudes; triangles Cbc^1 and cab are equal from having equal bases bc^1 and ab and same altitude; triangle Cab and $Cab_{''}$ are equal from having same base Ca and equal altitudes. It is now evident that the triangle evolved by the forces combined for any unity of time is equal not only to the one for the first unity of time but also to the one that would be evolved by the initial impulse of rotation combined with an attraction equal to the versid sine due to repulsion from rotation.

Measured, with reference to the arc $ab_{''}$ of the circle attraction is to repulsion as af to f'a, but measured with reference to the arc ab in the path of the particle acted upon by the forces combined attraction and repulsion are equal and in equilibrium in the production of arc ab or any other arc c in the path of revolution of the particle.

The following is the enunciation of a proposition well known to be true from demonstration. "If a body describes an ellipse, being continually urged by a force directed towards the focus, that force must vary inversely as the square of the distance." In the case, then, under consideration if

the attraction of the ellipsoid on the particle varied inversely as the square of the distance, the path of revolution would be an ellipse. In Dia. 11, let kl be any part of the elliptic path of revolution described in a unite of time. Take gk to fa inversely as $\overline{Ck}^2$ to $\overline{Ca}^2$, and draw gl and complte the parallelogram kglm. It is evident that the diagonal kl is the resultant effect of attraction kg being equal to the repulsion gk or lm. If the attraction then varied inversely as the cube or any other higher power of distance kg would be shorter than in the case just considered and the diagonal of equilibrium would be a line from k to some point between m and l. With a spherical central body, then, the path of revolution of the particle would be an ellipse, but with an ellipsoidal central body it is otherwise.

In the expression for the attraction of an oblate ellipsoid in the plane of the equator (Art. 22) subtitute (A) divided by (n) for (D) and the expression becomes:

$$\text{Att.} = \frac{M}{A^2}(n^2 + \tfrac{1}{2}\times\tfrac{2}{5}\, n^4E^2 + \frac{3}{2.4}\times\tfrac{3}{7}\, n^6\Gamma^4 + \text{etc.})$$

The sum of the elements $\frac{Mn^2}{A^2}, \frac{3}{10}\frac{Mn^4E^2}{A^2}$ etc., make up the attraction of the ellipsoid. The first element acting alone would cause the particle to revolve in an ellipse; but the other elements acting conjointly would cause it to move in a path continuously increasing the distance from the center of the ellipsoid, or the path would be a spiral evolved by a radius vector increasing continuously in length and also decreasing in angular velocity so as to generate equal areas in equal time. All of these elements combined evolve a resultant path having a radius vector increasing and decreasing during a revolution as the radius vector of an ellipse would increase and decrease while additionally and continuosly receiving increments of length. An appropriate appellation for the resultant path is elliptic spiral. The radius vector of an elliptic spiral generates equal areas in equal time. As far as observation has been able to determine each of the heavenly bodies rotates on an axis; it is, therefore, good common sense to conclude that every body in the heavens revolves in an elliptic spiral orbit continually with decreasing increments departing from its primary. When the particle is an interior one, then its repulsion or outward pressure depends upon the law of the interior attraction of the body.

25. It is evident without additional investigation that the repulsive effect from rotation parallel to the equator, decreases from equator to the poles as A cos O. Angle O is the elleptic angle measured from the plane of the equator.

26. To find the figure of a mass of homogeneous fluid due to rotation and mutual attraction of component particles, also to find the gravity at any point on the surface or within the rotating body.

From the nature of the case the two parts of the rotating fluid body as divided by the equatorial plane are similar and equal, and all sections par-

allel to that plane are circles. The body thus can be conceived, made up in an infinite number of laminæ or layers or shells so that the mass of the body within any layer may vary as the cube of the equatorial radius of the layer. The body can also be conceived, made up of an infinite number of eccentric cones or cones with eccentric bases, having their bases in the surface of the body and their vertices at the center of the equatorial section or center of body. These cones may be taken with such areas of base that their volumes shall vary as distance from base to center of body. In case the body in equilibrium is an ellipsoid, it can be conceived, made up of an infinite number of elliptic cones or cones with elliptic bases. If each elliptic cone has an elliptic base with one principal axis, of length due it per the system of dividing the ellipse extending from either pole of the ellipsoid to the equator per law of alpha or beta elliptic angles (see Art. 14 and Diagram 5), and the other principal axis of length due it from proportional distance from center of the ellipsoid, then the cones have equivolent bases and their volumes vary as distances from bases to center of body. Per the expedient of the layers and the cones, any layer by the cones is conceivably cut up into infinitesimal parts, so that each part has mass proportional to its distance from the center of the body.

Fluid equilibrium, or a state of rest for any and all of the component particles requires that the pressure from any infinitesimal part of a layer on the fluid interior shall just equal that of any other part of same layer having the same layer surface area.

Such ultimate parts of a layer may be called layer elements of mass. As all sections of the rotating fluid body, parallel to the plane of the equator must be circles, and as the equatorial plane must divide the body into two equal parts whatever the figure of a section in a plane of the axis of rotation, a line of layer elements of mass in either polar radius must balance a line of elements in an equatorial radius. It is safe then to take as granted that gravity at either pole to gravity at the equator is inversely as polar to equatorial radii. As the sphere is the figure of equilibrium for a fluid body not rotating, and as a sphere rotated on a center axis generates a centrefugal or repulsive force in lines of ordinates of axis, proportional to lengths of ordinates, and as the oblate ellipsoid is the only figure that has the required relations to the sphere to continue a fluid mass in equilibrium in passing from a state of rest to a condition of rotation, it is safe to take as granted that such is the figure of equilibrium for a rotating mass, providing it be demonstrated that every element of mass of a layer presses, each to each, equally on interior mass.

The general expression for attraction on a particle at the surface of an ellipsoid, is:

$$\text{Att.} = \frac{M}{A^2}\left[\ 1 + \frac{4}{5}\,h - \frac{1}{5}\,h\sin^2 O + \frac{18}{35}h^2 - \frac{53}{350}h^2\sin^2 O - \frac{1}{50}h^2\sin^4 O + h^3\,(''') + ''\ \right]$$

To satisfy the conditions the elliptic angle (O) in the above must be meas-

ured from the polar axis. The following is an equivelent expression with the elliptic angle (O) measured from an equatorial radius:

$$\text{Att.} = \frac{M}{A^2}\left[\ 1+\frac{4}{5}\,h-\frac{1}{5}\,h\,\cos^2 O+\frac{18}{35}h^2-\frac{53}{350}h^2\cos^2 O-\frac{1}{50}h^2\cos^4 O+h^3\,(\text{''})+\text{''}\ \right]$$

Let a represent an equatorial radius varying from O to A, then for mass interior to any layer M varies as (a) cube, hence interior attraction varies as a. For interior attraction a can be substituted for M divided by A^2. h in the above expression for attraction equals A—B divided by A. To put the expression in shape so that h may represent unity divided by A, the constant terms $1+\frac{4}{5}h+\frac{18}{35}h+$etc., so far as used in the computation must be made unity. The same result is obtained by not making this change, providing due allowances are made for A—B not being equal to unity.

$$\text{Att} = a\,[1-\tfrac{1}{5}\,h\,\cos^2 O\ -\ \tfrac{53}{150}\,h^2\,\cos^2 O-\tfrac{1}{50}\,h^2\cos^4 O-h^3\,(\text{''})-\text{''}].$$

The difference in attraction for any point on the polar radius and same layer point on the equatorial radius is:

$$\left(\frac{1}{5}\,h+\frac{6}{35}\,h^2+\frac{4}{35}\,h^2+\text{''}\right)$$

When the rotating fluid body is in equilibrium the mass from a layer in any equatorial cone must just balance the mass from same layer in either of the polar cones. As these masses vary as their distances from the center of the body, gravity in the plane of the equator and in the polar axis must vary inversely as same distances, and the centrifugal force or repulsion from rotation in the plane of the equator must, in case of equilibrium, be expressed by,

$$a\,h-a\left(\frac{1}{5}\,h+\frac{6}{35}\,h^2+\text{''}\right)=a\left(\frac{4}{5}h-\frac{6}{35}\,h^2-\text{''}\right)$$

The repulsion from rotation at any point in or on the rotating body in direction parallel to the equatorial plane is per demonstration (Art. 25),

$$\text{Rep.} = a\cos O\left(\frac{4}{5}\,h-\frac{6}{35}\,h^2-\frac{4}{35}\,h^3-\text{''}\right)$$

Gravity is the third side of a triangle in which the two sides (attraction and repulsion of rotation) and the included angle $[(O-z)+(\alpha-w)]$ are given. The third side or

$$\text{Gravity} = \left\{\overline{\text{Att.}}^2+\overline{\text{Rep.}}^2-2\ \text{Att.}\times\text{Rep.}\times\cos\,[(O-z)+(\alpha-w)]\right\}^{\frac{1}{2}}$$

$$\text{Gravity} = a\left[1-h\,\cos^2 O+\tfrac{1}{2}h^2\cos^2 O-\tfrac{1}{2}\,h^2\cos^4 O+h^3(\text{''})-\text{''}\right]$$

The expression for any radius of an oblate ellipsoid in terms of ellipticity and sine of elliptic angle (O) in which angle angle (O) is measured from an equatorial radius is:

$$A_{,} = A \left[1 - h \sin^2 O + \tfrac{1}{2} h^2 \sin^2 O - \tfrac{1}{2} h^2 \sin^4 O \pm h^3 (_{,,}) \pm _{,,} \right]$$

For any point ($a_{,}$) on the surface or within the ellipsoid:

$$a_{,} = a \left[1 - h \sin^2 O + \tfrac{1}{2} h^2 \sin^2 O - \tfrac{1}{2} h^2 \sin^4 O + h^3 (_{,,}) - _{,,} \right]$$

The above expressions for gravity and radial distance prove that gravity for all points in the same layer of the ellipsoid varies inversely as distance from point to center of body. To comprehend how this result satisfies the second test for equilibrium in full it must be understood in the expedient of the infinitesimal layers and cones, that the same system of cones is used only to divide up one or any one layer. The point now required to be proven is that when any cone is so moved that its axis is changed to the normal or direction of gravity, without changing the point of base on the layer, the cone cuts the same mass from the layer as when in first position. The expedient used to divide up the layer requires the ellipse to be described with a variable radius with the center fixed at the center of the ellipse. Per law of ultimate ratio the radius is constant in describing an infinitesimal arc. The same ellipse can be conceived described with the same variable radius, and with that radius kept on the normal or indirection of gravify, providing the center so vary in locations that the describing end of the radius be kept on the ellipse to be described. In this case the ellipse is known, because it is the one describ d by the first method. For any point of the curve, then, the center in the normal, or in direction of gravity is known. Per law of ultimate ratio by this method an infinitisimal arc of the ellipse is described with the same constant radius as in first instance, and with a fixed center. The same infinitesimal arc of the ellipse, then, is described by either expedient. Therefore the cone in either position cuts from the same layer the same volume or mass.

A fluid mass takes on a spherical figure from the mutual attraction of component particles. If such spherical body receives an initial impulse of rotation sufficient to cause one complete rotation during infinity of time, then the ultimate ratios initiated for change of figure are those, and those only, that are due to change from a sphere to an oblate ellipsoid. This should be taken as demonstrat on that the oblate ellipsoid is the figure of equilibrium and alone that figure. unless there is real ground for positive proof otherwise.

VIII.

The Figure of Equilibrium, the Density and Temperature of the Earth and Other Planets.

First.—The oblate Ellipsoid is the figure of equilibrium of a rotating fluid mass of heterogeneous density, and all solids manifest the fluid property in some degree under a requisite continued pressure.

Second.—The average density of the earth's crust in depth about 130 miles is 2.96 times water, and at the center about 3.05 times that of the crust, or 9 times water. At other points the density is given in table 4, this chapter.

Third.—The temperature of the earth from surface to center at first increases about 1° C. per 90 feet, but this rate of increase so diminishes that at the depth of 130 miles the temperature becomes about 3,600° C. Thence to the center the rate of increase is so small that the temperature continues nearly uniform.

Fourth.—The earth has yet to cotract, radially, about 150 miles to become throughout zero temperature. The interior flames will be, continually, fed by the fuel of pressure of outside load to a limit beyond which the earth's mass cannot compress. The present interior, at a few miles below the surface begins to get plastic, and from about 130 miles below the surface to the center it becomes so plastic that the temperature is kept nearly uniform by convection of heat.

NOTE.—The density of a fluid earth composed, throughout, proportionally of the same elements would increase from surface to center, not withstanding the commotion produced by the heat generated by pressure. In case of such an earth at 15° C., if there were no heat from pressure, and therefore a state of rest, its increase in density would be per law of compression. If heat sufficient to raise the temperature of the whole mass 50° C. were put into such earth so as to leave surface at 15° C., and have the increase in tempergture from surface to center per law of compression, then in case no heat escaped, per law of convection there would be no state of rest till the whole mass became of uniform temperature, 65° C. It is evident, then, that an earth having a crust with moulten interior would be at a state of rest proportionally to the thickness and non-conducting heat property of its crust. Not with-standing the moulton interior of the earth (if she has such) is now at temperature nearly uniform, yet I suppose before the crust solidified or become plastic that heat radiated into cold space so rapidly that in spite of the law of convection, the temperature at the center of the earth was thousands of degrees higher than at the surface. The heighth to which material is now being thrown from the sun, proves that the temperature at his center is higher beyond com-

prehension than at his surface. Let those believing solidification commenced at the center keep these facts in mind while reading this chapter.

27. To find the decrease in attraction on a rotating fluid oblate ellipsoid from the poles to the equator.

Conception 1st. Such an oblate Ellipsoid can be conceived made up of an infinite number of oblate Ellipsoids having a common center, and each component Ellipsoid of homogeneous density.

Conception 2d. The same oblate Ellipsoid can be conceived made up also in shells or layers with each shell or layer of homogeneous density. The surface of the layers in this case would be at the surface of the component Ellipsoids of conception first.

The attraction of each component ellipsoid can be computed by formulae already developed for homogeneous ellipsoids, and the attraction for the heterogeneous mass is equal to the sum of the attractions of the component parts.

The attraction of first or largest component ellipsoid at pole is:

$$\frac{m}{B^2}\left[1-\frac{3\,E^2}{5\,(1-E^2)}+\,''\right]=\frac{m}{A^2}(1+\tfrac{2}{5}\,E^2+\,'')$$

The attraction at equator of same is:

$$\frac{m}{A^2}\,(1+\tfrac{3}{10}\,E^2+\,'')$$

Decrease from pole to equator is:

$$\frac{m}{A^2}\,(\tfrac{1}{10}\,E^2+\,'')=\frac{m}{A^2}\,(\tfrac{1}{5}\,H+\,'')$$

The attraction at the pole of first ellipsoid for the second component ellipsoid is:

$$\frac{m_1}{B^2}\left[1-\frac{3b^2\,E^2}{5\,B^2\,(1-E^2)}+\,''\right]=\frac{m_1}{A^2}\left[\frac{1}{1-E^2}-\frac{3\,a^2\,E^2}{5\,A^2\,(1-E^2)^2}\right]=\frac{m_1}{A^2}$$

$$\left[1+E^2+\,''-\tfrac{3}{5}\,n^2\,E^2+\,''\right],\text{ in which } n^2=\frac{a}{A^2}.$$

The attraction at equator for same is:

$$\frac{m_1}{A^2}\left[1+\tfrac{3}{10}\,n^2\,E^2+\,''\right].$$

Decrease is:

$$\frac{m_1}{A^2}\left[2\,H-\tfrac{9}{5}\,h\,n^2\pm\,''\right].$$

Results are thus obtained for all the component ellipsoids.

The decrease in attraction from pole to equator of the heterogeneous oblate ellipsoid or sum of results for component ellipsoid is:

$$\frac{2\,H}{A^2}\,(m+m_1+m_2+m_3+\text{etc.})-\frac{9}{5\,A^2}\,(m\,H+m_1\,n^2\,h+m_2\,n_1^2\,h_1+m_3\,n_2^2\,h_2+\text{etc.}).$$

The general expression for the attraction of a homogenous oblate ellipsoid on any outside particle, when modified by the requisite substitutions, proves that the decrease in attraction from the equator to the pole of the heterogenous ellipsoid, caused by any of the interior component homogeneous ellipsoid, varies in accordance with the law for a homogeneous oblate ellipsoid, when the attracted particle is at any point on the surface. The decrease in attraction then, from the equator to the pole, true for the second power of eccentricity, varies as the square of the sine of the elliptic angle, or the angle of *geocentric latitude.*

28. To find the decrease in attraction of an oblate ellipsoid on a particle in the surface of any layer from the plane of the equator to a polar radius.

Under the conditions of this discussion, when a heterogeneous ellipsoid becomes homogeneous, then all the layers become similar and of equal ellipticity. The layers of the heterogeneous ellipsoid can be made similar by taking away certain crescent pieces. To determine the attraction on any particle in the surface of any interior layer, the attraction of certain outside crescent pieces and the interior mass need only be considered, as all the other exterior mass attracts the particle equally in opposite directions.

In the last article an expression is developed that can be used to determine the attraction of the interior mass. A method to find the attraction of the crescent pieces become manifest from diagram 4. The attraction on particle P of that portion of the ellipsoid cut out by rotation of the lines Pe and Pg depends upon the length of chord dg or ce, when angle g Pe is small or infinitesimal. The point of tangency a bisects chord d g. The length of chord d g varies as diameter $B_1 B_1$. The diameter $B_1 B_1$ becomes longer by increasing the ellipticity. When point P is moved to the interior of the ellipsoid, that portion of the chord d g, as shown in diagram 2, by Pd, is equal to gg_1, in case the ellipsoid is composed of similar layers, or is of homogeneous density. If the ellipsoid is composed of layers of decreasing ellipticities or with density increasing from surface to center, then Pd is less than gg_1. The angle P ax of diagram 4 is a right angle by construction, and PaC is less than a right angle. The angle Cax, or angle α, or the *angle of the vertical* bacomes nothing when the layer, of which a is the point of tangency becomes a circle. When the ellipticity of the ellipse having a in point of tangency is less than that of the ellipse BA BA, then the difference between gg_1 and Pd of diagram 2, or the attraction for the external crescent pieces is at ained from the expression already obtained for the sine of angle α or the angle of the vertical.

$$\sin \alpha = E^2 \sin \vartheta \cos \vartheta + \ldots = 2 h \sin \vartheta \cos \vartheta + \ldots$$

When point of tangency a, of diagram 4, is in the surface of the layer, and point P is moved in semi axis BC, to the surface of the same layer,

then the radius for the angle α for any direction of chord dg cutting the layer, varies in length from zero to semi axis b. The general expression for any of the radii is, b sin ϑ.

Let E be the eccentricity and H the ellipticity of the outside layer. The expression for the sine of the angle of the vertical for the ellipse having semi minor axis b and eccentricity E is, $\sin \alpha = b\, E^2 \sin^2 \vartheta \cos \vartheta$.

The expression for the sine of the corresponding *angle of the vertical* for a layer having semi minor axis b and eccentricity e is, $\sin \alpha_{,} = b\, e^2 \sin^2 \vartheta \cos \vartheta$.

$$gg_{,} - Pd = 2 \sin \alpha - 2 \sin \alpha_{,}.$$

The expression for any chord of a layer drawn from a pole of the layer is, 2 b cos ϑ.

$$\frac{gg_{,} - Pd}{2\, b \cos \vartheta} = (E^2 - e^2) \sin^2 \vartheta = 2\,(H - h) \sin^2 \vartheta.$$

The attraction of the mass cut from a homogeneous oblate ellipsoid having semi minor axis b and eccentricity e, by any two chords drawn from a pole, the one chord making an infinitesinal angle with the other is:

$$Att. = \frac{m}{b^2}\,(1 - \tfrac{3}{2}\, e^2 \sin^2 \vartheta + _{,,}).$$

The attraction then of the mass cut from the whole ellipsoid having semi minor axis B and eccentricity E by the two chords extended, on a particle at the pole of the interior layer, having semi minor axis b and eccentricity e, providing the density of the whole mass is homogeneous, is

$$Att. = \frac{m}{b^2}\,(1 - \tfrac{5}{2}\, e^2 \sin^2 \vartheta + E^2 \sin^2 \vartheta + _{,,})$$

To make summation for whole ellipsoid we must put, as hertofore:

$$\sin^2 \vartheta = \tfrac{2}{5}.$$

$$\sin^4 \vartheta = \frac{2_{,}\,4}{5_{,}\,7}, \text{ etc:, for higher powers.}$$

For whole ellipsoid as above described, then, on particle at pole of layer:

$$Att. = \frac{m}{b^2}\,(1 - e^2 + \tfrac{2}{5}\, E^2 + _{,.}) = \frac{m}{a^2}\,(1 - O + \tfrac{2}{5}\, E^2 + _{,,}).$$

Likewise obtained for particle in equator of same layer:

$$Att. = \frac{m}{a^2}\,(1 + \tfrac{1}{2}\, e^2 - \tfrac{1}{5}\, E^2 + _{,,}).$$

Attraction at pole, then, less that of the equator, is:

$$Dif.\ of\ Att. = \frac{m}{a^2}\,(\tfrac{3}{5}\, E^2 - \tfrac{1}{2}\, e^2 + _{,,}) = \frac{m}{a^2}\left[\tfrac{1}{5}\, h + \tfrac{6}{5}\,(H - h) + _{,,}\right].$$

An oblate ellipsoid having semi-minor axis B, and ellipticity H, and density increasing from surface to center can be made up of a homogeneous oblate ellipsoid, having semi minor axis b and ellipticity h, with density the same as layer having semi minor axis b and ellipticity h, and of other homogeneous oblate ellipsoids having semi minor axis less than b and ellipticities less than h, and also an outside part, composed of layers having semi minor axes varying from B to b, with ellipticities varying from H to h.

Let l be the density of the layer having semi minor axis b. For the outside crescent masses there can be substituted one crescent mass of the same volume as the sum of the crescent masses, with a density, so as to give an equivolent attractive effect. Let this density be c times the surface density of the heterogeneous ellipsoid. Let M be the mass of the whole heterogeneous ellipsoid, M the mass of the homogeneous ellipsoid, having density l, and m, m_1, m_2. etc., the masses of the homogeneous ellipsoids having semi minor axis less than b.

It is now evident from investigations already made, that for the surface of any layer, the attraction at the pole of the layer, less that at the equator, can be expressed as follows:

$$\text{Diff. of Att.} = \frac{M}{M}\left[\tfrac{1}{5}\,h + \frac{6\,c}{5\,l}(H - h)\right] + \frac{2h}{M}(m + m_1 + m_2 + \text{etc.})$$

$$-\frac{9}{5M}(m\,h + m_1\,n^2\,h_1 + m_2\,n_1^2\,h_2 + \text{etc.})$$

The result from the general expression for the attraction of a homogeneous oblate ellipsoid on any outside particle, when the requisite substitutions for the case under consideration are made, proves that the decrease in attraction on the surface of any layer from its pole to its equator varies in accordance with the law for the homogeneous oblate ellipsoid at its surface.

29. To find the figure of equilibrium of a fluid rotating mass, increasing in density from surface to center.

The attraction at the surface of any layer at its equator being less than at its poles, the thickness of any layer at its equator is greater than at its poles. As the decrease in attraction on the surface of any layer varies per law for the surface of a homogeneous oblate ellipsoid, the increase in the thickness of the layer as caused by attraction, must follow the law for the increase in the radii of an oblate ellipsoid. The effect of the centrifugal force to give its additional increase of ellipticity follows for the layer the law for the surface of the homogeneous ellipsoid. The combined effects, then, of attraction and centrifugal force, or gravity, cause each layer to be an oblate ellipsoidal layer, or the figure of equilibrium of all layers to be, also that of an oblate ellipsoid.

30. To find the density of the earth from surface to center, the mean density being $\frac{10}{21}$ times greater than that of a surface layer 127 miles deep.

The increase in the density of liquids caused by pressure, as shown by Oersted's apparatus and other experiments, varies as the pressure, measured under the condition of constant temperature. Gasses follow the same law. Deschanel says, "The true compressibility of water, according to recent experiments conducted under the direction of M. Jamin, by Messrs. Amaury and Descamps, is at the temperature of 15° Centigrade .0000427 per atmosphere." In these experiments the compressibility of glass was taken to be 0000029 per atmosphere. The fact that solids can be compressed shows that solids possess the fluid property essential to compressibility. The fact that rocks are found bent which once were straight, also that a pane of glass or a slab of marble can be bent by a certain continued pressure demonstrates that the particles of solids can move on each other. The movements of solid ice in glaciers is proof in the same direction. The effect of pressure above and below the columns left for supports in deep mines gives like testimony. The deep canyons of Colorado permit the water to cut so deep and no deeper, because below a certain depth the solid rock bottom like putty, rises from weights of high banks.

It is the theory of the geologist that the earth, below a thin solid crust, begins to become plastic, and at certain small depth becomes so plastic that the temperature thence to the center can only slightly increase, owing to the *law of convection of heat.* If the theory of the geologist be true, then the increase in the density of the interior of the earth caused by pressure varies as outside pressure. It is only in the case the theory is not true that we need trouble ourselves about the shadow of a doubt that remains in reference to the law of compressibility of fluids applying to solids.

If computations made by formulæ already developed, modified by the condition of the theory of the geologist, builds up the earth from center to surface in layers, giving the difference of gravity of corresponding layer points in polar and equatorial radius in harmony from center to surface and exactly meets the observed difference of gravity at the surface, likewise for ellipticity of layers so as to meet the observed ellipticity at surface, also giving a computed direction for gravity at the surface at any latitude exactly in agreement with the observed direction, then it seems to me it must be accepted that the theory of the geologist is truth, and that the theory of the astronomer, based on computations made from uncertain data is a fallacy.

TABLE I.

1.	2.	3.	4.	5.	6.	7.	8.
No. Layer.	Volume.	Incr. Dens.	Density.	Mass Layers	Mass H.—Ellipsoids.	Ellipticity.	$-\frac{2}{5}$ h n^2 m.
31	2791	.....	1.0000	2791	29791	$\frac{1}{294}$	—.0032142
30	5048	.12675	1.1267	5687	3421	$\frac{1}{298.2}$	3408
28	4376	.2623	1.3890	6078	5758	$\frac{1}{305.6}$	4875
26	3752	.2876	1.6766	6291	5058	$\frac{1}{312}$	3617
24	3176	.3020	1.9788	6284	4174	$\frac{1}{317.3}$	2501
22	2648	.3012	2.2800	6037	3207	$\frac{1}{321.6}$	1593
20	2168	.2841	2.5641	5559	2272	$\frac{1}{324.9}$	923
18	1736	.2510	2.8161	4888	1469	$\frac{1}{327.5}$	480
16	1352	.2091	3.0252	4090	857	$\frac{1}{329.3}$	220
14	1016	.1613	3.1865	3237	442	$\frac{2}{330.5}$	86
12	728	.1148	3.3013	2403	198	$\frac{1}{331.4}$	28
10	488	.0744	3.3757	1647	74	$\frac{1}{331.7}$	7
8	296	.0430	3.4187	1012	22	.....	1
6	152	.0213	3.4400	523	4.6	.....	.....
4	56	.4083	3.4483	193	.53	.....	.....
2	8	.0020	3.4503	27	.014	.....	.....
....	29791	.....	.....	56747	56747	.....	—.0049881

The numbers in column 1, table 1, represent the polar radii of similar elliptic layers or shells composing an oblate ellipsoid. The numbers in column 2 are the differences between the cubes of 31 and 30, 30 and 28, 28 and 26, etc. As the volumes of similar oblate ellipsoids vary as the cubes of their polar radii, the numbers in column 2 are proportional to the volumes of the component layers. The mean density of the earth as attained by experiments is, at least very nearly, $\frac{40}{21}$ times that at surface. The whole mass of the earth, then, may be represented by 31 cubed multiplied by $\frac{40}{21}$, or 56745, or by 56745 divided by 56745. The first number in column 3 is so assumed as to give the requisite mass in the earth under the law that the increase in compression or density varies as pressure. The other numbers in this column are computed and show the increments in density from layer to layer. The numbers in column 4 are the computed densities of the layers, and those in column 5 divided by 56745, the masses. The pressure of the outside layer compared with that of any other, varies as the attraction of the ellipsoid on the masses of these layers. The increment of density for the pressure of any interior layer is found by multiplying the assumed increment .12675 by the pressure of the interior layer divided by the pressure of the outside layer.

The numbers in column 6, divided by 56745 are the masses of the homogeneous ellipsoids, having radi, 31, 30, 28, etc., composing also the ellipsoid, and these numbers are found by multiplying the cubes of the numbers of column first by those of column third, excepting the first number, which is 31 cubed The numbers in column 7 are explained in connection with table 4.

The formulæ already developed for the attraction of a heterogeneous oblate ellipsoid at the pole less that at the equator, is:

$$\text{Diff. of Att.} = \frac{2H}{A^2}(m + m_1 + m_2 + \text{etc}) - \frac{9}{2A^2}\ (m\,H + m_1 n^2 h + m_2 n_1^2 h_1 + \text{etc})$$

For the purpose of this computation A, and $m + m_1 + m_2$ + etc., or M, can each be made unity, and the formulæ put in form as follows:

$$\text{Diff. Att.} = 2H - \tfrac{2}{5} m H - \tfrac{2}{5} m_1 n^2 h - \tfrac{2}{5} m_2 n_1^2 h_1 - \text{etc.}$$

The numbers in column 8 are the computed results of $-\frac{2}{5} m H$, $-\frac{2}{5} m_1 n^2 h$ — etc

TABLE II.

1.	2.	3.	4.	5.	6.	7.	8.
No. Layer.	Volume.	Incr. Den.	Density.	Mass Layer.	Mass H. — Ellipsoid.	Ellipticity.	$-\frac{2}{5} h n^2 m.$
31	2791	.....	1.0000	2791	29791	$\frac{1}{294}$	—.0032142
30	2611	.11867	1.1187	2921	3202	$\frac{1}{298.2}$	3190
29	2437	.1261	1.2448	3033	3075	$\frac{1}{302}$	2827
28	2269	.1326	1.3774	3125	2910	$\frac{1}{305.6}$	2464
27	2107	.1378	1.5152	3192	2712	$\frac{1}{309}$	2112
26	1951	.1415	1.6567	3232	2487	$\frac{1}{312}$	1779
25	1801	.1435	1.8002	3242	2242	$\frac{1}{314.8}$	1469
24	1657	.1436	1.9438	3220	1985	$\frac{1}{317.3}$	1190
23	1519	.1418	2.0856	3168	1725	$\frac{1}{319.6}$	942
22	1387	.1379	2.2235	3084	1468	$\frac{1}{321.6}$	729
21	1261	.1322	2.3557	2970	1224	$\frac{1}{323.4}$	551
20	1141	.1248	2.4805	2830	998	$\frac{1}{324.9}$	406
19	1027	.1160	2.5965	2666	795	$\frac{1}{326.3}$	290
18	919	.1060	2.7025	2483	618	$\frac{1}{327.5}$	202
17	817	.0953	2.7978	2285	468	$\frac{1}{328.5}$	136
16	721	.0842	2.8820	2077	344	$\frac{1}{329.3}$	88
15	631	.0730	2.9550	1864	246	$\frac{1}{330}$	55
14	547	.0622	3.0172	1650	170	$\frac{1}{130.6}$	33
13	469	.0519	3.0691	1439	114	$\frac{1}{331.1}$	19
12	397	.0423	3.1114	1235	73	$\frac{1}{331.4}$	10
11	331	.0338	3.1452	1041	51	$\frac{1}{332}$	6
10	271	.0262	3.1714	859	26	$\frac{1}{332}$	3
9	217	.0197	3.1911	692	14	.....	.....

TABLE II — continued.

1.	2.	3.	4.	5.	6.	7.	8.
No. Layer.	Volume.	Incr. Den.	Density.	Mass Layer.	Mass H.— Ellipsoid.	Ellipticity.	$-\frac{2}{5}$ h n² m.
8	169	.0143	3.2054	541	7	.....	.....
7	127	.0100	3.2154	408	3.4	.....	.....
6	91	.0066	3.22 0	293	1.3	.....	.....
5	61	.0041	3.2261	196.8	.5	.....	.....
4	37	.0023	3.2284	119.4	.14	.....	.....
3	19	.0011	3.2295	61.4	.029	.....	.....
2	7	.0004	3.2299	23.7	.003	.....	.....
1	1	.0002	3.2301	3.23	.000	.....	.....
....	29791	.....	.....	56733.53	56750.372	.....	—0050643

Tables 2 and 3 are made on plan of table 1.

2 H = $\frac{1}{147}$ = .0068027.

Table 1 gives: .0068027 — .0049881 = .0018146 for difference in attraction.

Table 2 gives: .0068027 — .0050643 = .0017384 for difference in attraction.

Table 3 gives: .0068027 — .0051030 = .0016997 for difference in attraction.

The difference between first result and second is .0000762, and that of second and third, 0000384. The first difference is about double that of the second. From these differences we can closely estimate what would be the result in case the outside layer be kept of thickness one thirty-first part of radius, and the other layers be reduced to infinitesimal thickness. The result in that case for attraction at pole less that at the equator would be about .001665, or $\frac{1}{600}$.

The observed gravity at the pole, less that at the equator, is $\frac{1}{193}$; and the centrifugal force at the equator is $\frac{1}{289}$, and nothing at the pole. The observed attraction at the pole, less that at the equator, is: $\frac{1}{193} - \frac{1}{289} = \frac{1}{600}$.

I find by computations that a true result for attraction cannot be attained in accordance with observed and known data, and divide the earth, from surface so center into layers infinitesimally thin. To meet that data an outside layer of about

TABLE III.

1.	2.	3.	4.	5.	6.	7.	8.
31	2791	.....	1.0000	2791	29791	$\frac{1}{291}$	—0032142
30	1327⅝	.1151	1.1151	1480	3107	$\frac{1}{298.2}$	3095
29½	1283⅝	.0620	1.1771	1510	1519	$\frac{1}{300}$	1523
29	1239⅞	.0636	1.2407	1538	1551	$\frac{1}{302}$	1426
28½	1197½	.0651	1.2058	1563	1507	$\frac{1}{303.7}$	1330
28	1155½	.0664	1.3722	1585	1457	$\frac{1}{305.6}$	1234
27½	1113½	.0676	1.4389	1603	1406	$\frac{1}{307.2}$	1142
27	1073⅜	.0685	1.5083	1619	1348	$\frac{1}{309}$	1050
26½	1034⅜	.0693	1.5776	1630	1289	$\frac{1}{310.5}$	962
26	994⅝	.0698	1.6474	1638	1227	$\frac{1}{312}$	876
25½	956⅜	.0701	1.7175	1642	1162	$\frac{1}{313.8}$	796
25	918⅝	.0702	1.7877	1642	1097	$\frac{1}{314.8}$	719
24½	882½	.0700	1.8577	1638	1029	$\frac{1}{316}$	645
24	846½	.0696	1.9273	1630	962	$\frac{1}{317.3}$	576
23½	810⅞	.0689	1.9962	1618	894	$\frac{1}{318.4}$	512
23	776⅜	.0680	2.0642	1602	827	$\frac{1}{319.6}$	452
22½	742⅜	.0669	2.1311	1582	762	$\frac{1}{320.6}$	397
22	709⅝	.0655	2.1966	1558	697	$\frac{1}{321.6}$	346
21½	677⅜	.0639	2.2605	1530	635	$\frac{1}{322.6}$	300
21	645⅞	.0623	2.3228	1500	577	$\frac{1}{323.4}$	260
20½	615½	.0602	2.3830	1465	518	$\frac{1}{324.2}$	222
20	585½	.0581	2.4411	1428	465	$\frac{1}{324.9}$	189
19½	555⅞	.0558	2.4969	1388	413	$\frac{1}{325.6}$	159
19	527⅜	.0534	2.5503	1345	366	$\frac{1}{326.3}$	133
18½	499⅜	.0509	2.6012	1299	322	$\frac{1}{327}$	111
18	472⅝	.0483	2.6495	1252	281	$\frac{1}{327.5}$	92
17½	446⅜	.0450	2.6951	1203	244	$\frac{1}{328}$	75
17	420⅞	.0429	2.7380	1152	211	$\frac{1}{328.5}$	61
16½	3 6½	.0402	2.7782	1100	180	$\frac{1}{328.9}$	49
16	372½	.0375	2.8157	1048	153	$\frac{1}{329.3}$	39
15½	348⅞	.0348	2.8505	994	129	$\frac{1}{329.7}$	31
15	326⅜	.0322	2.8827	941	108	$\frac{1}{330}$	24
14½	304⅜	.0297	2.9124	887	90	$\frac{1}{330.3}$	19
14	283⅜	.0272	2.9396	834	74	$\frac{1}{330.6}$	14
13½	262⅜	.0248	2.9644	781	61	$\frac{1}{330.9}$	11
13	243⅛	.0224	2.9868	728	49	$\frac{1}{331.1}$	8
12½	225⅛	.0202	3.0070	677	39	$\frac{1}{331.3}$	6
12	207¼	.0182	3.0252	627	31	$\frac{1}{331.4}$	4
11½	189⅞	.0161	3.0413	577	24	$\frac{1}{331.5}$	.....
11	173⅜	.0143	3.0556	530	19	$\frac{1}{331.6}$	.....
10½	157⅝	.0126	3.0682	484	15	$\frac{1}{331.7}$	.....
10	142⅝	.0109	3.0791	439	11	.....	.....
9½	128⅜	.0095	3.0886	396	8	.....	.....
9	114⅞	.0081	3.0967	356	5.9	.....	.....
8½	102⅛	.0069	3.1036	317	4.2	.....	.....
8	90¼	.0058	3.1094	281	3	.....	.....
7½	78¾	.0048	3.1142	246	2	.....	.....
7	68⅜	.0040	3.1182	213	1.37	.....	.....
6½	58⅝	.0033	3.1215	183	.90	.....	.....
6	49⅝	.0026	3.1241	155	.56	.....	.....
5½	41⅜	.0020	3.1261	129	.33	.....	.....
5	33¾	.0016	3.1277	106	.20	.....	.....
4½	27⅛	.0011	3.1288	84.9	.10	.....	.....
4	21¼	.0008	3.1296	66.1	.05	.....	.....

TABLE III — continued.

1.	2.	3.	4.	5.	6.	7.	8.
$3\frac{1}{2}$	$15\frac{7}{8}$	.0006	3.1302	49.7	.03	.....	.....
3	$11\frac{29}{32}$	.0004	3.1306	35.6	.01	.....	.....
$2\frac{1}{2}$	$7\frac{25}{32}$	.0002	3.1308	23.8	.....	.....	.....
2	$4\frac{3}{32}$	.0001	3.1309	14.5	.....	.....	.....
$1\frac{1}{2}$	$2\frac{29}{32}$	.....	3.1309	7.3	.....	.....	.....
1	$\frac{7}{32}$	.....	3.1309	2.7	.....	.....	.....
$\frac{1}{2}$	$\frac{1}{32}$	.....	3.1310	.4	.....	.....	.....
.....	29791	.....	.....	56745	.....	.....	−0051030

TABLE IV.

No. L.	Mass Layer.	Mass H. E.	Dens.	Cres. D.	Cen. Force.	Att.	Gravity.	Polar Radii.	Equatorial Radii.	Ellipticity.
1	2	3	4	5	6	7	8	9	10	11
31	2791	29791	1.00	1.00	$\frac{1}{289}$	$\frac{1}{598}$	$\frac{1}{1948}$	3950.0000	3963.5136	$\frac{1}{293.3}$
30	3058	6235	1.11	1.05	$\frac{1}{303.2}$	$\frac{1}{678}$	$\frac{1}{2095}$	3822.5806	3835.4641	$\frac{1}{297.6}$
29	3168	3026	1.24	1.11	$\frac{1}{316.7}$	$\frac{1}{718}$	$\frac{1}{2198}$	3695.1612	3707.4496	$\frac{1}{301.6}$
28	3250	2787	1.37	1.16	$\frac{1}{329.9}$	$\frac{1}{758}$	$\frac{1}{2330}$	3567.7418	3579.4618	$\frac{1}{305.4}$
27	3303	2542	1.50	1.21	$\frac{1}{342.9}$	$\frac{1}{798}$	$\frac{1}{2440}$	3440.3234	3451.4991	$\frac{1}{308.9}$
26	3326	2265	1.64	1.26	$\frac{1}{355.5}$	$\frac{1}{837}$	$\frac{1}{2495}$	3312.9030	3323.5579	$\frac{1}{311.9}$
25	3316	1997	1.78	1.31	$\frac{1}{367.6}$	$\frac{1}{875}$	$\frac{1}{2585}$	3185.4836	3195.6365	$\frac{1}{314.7}$
24	3274	1719	1.91	1.35	$\frac{1}{379}$	$\frac{1}{911}$	$\frac{1}{2676}$	3058.0642	3067.7319	$\frac{1}{317.3}$
23	3198	1449	2.04	1.38	$\frac{1}{388.58}$	$\frac{1}{945}$	$\frac{1}{2776}$	2930.6448	2939.8425	$\frac{1}{319.6}$
22	3091	1196	2.17	1.42	$\frac{1}{399.59}$	$\frac{1}{978}$	$\frac{1}{2854}$	2803.2254	2811.9667	$\frac{1}{321.9}$
21	2960	968	2.29	1.45	$\frac{1}{409.1}$	$\frac{1}{1008}$	$\frac{1}{2991}$	2675.8060	2684.1058	$\frac{1}{323.4}$
20	2802	768	2.40	1.48	$\frac{1}{417.5}$	$\frac{1}{1036}$	$\frac{1}{2976}$	2548.3866	2556.2521	$\frac{1}{325}$
19	2622	591	2.51	1.50	$\frac{1}{424.9}$	$\frac{1}{1062}$	$\frac{1}{3036}$	2420.9672	2428.4080	$\frac{1}{326.4}$
18	2427	446	2.60	1.52	$\frac{1}{431.5}$	$\frac{1}{1083}$	$\frac{1}{3086}$	2293.5478	2300.5725	$\frac{1}{327.6}$
17	2220	323	2.87	1.43	$\frac{1}{437.3}$	$\frac{1}{1104}$	$\frac{1}{3133}$	2166.1284	2172.7420	$\frac{1}{328.5}$
16	2006	226	2.76	1.54	$\frac{1}{442.3}$	$\frac{1}{1121}$	$\frac{1}{3178}$	2038.7090	2044.9179	$\frac{1}{329.4}$
15	1791	157	2.82	1.55	$\frac{1}{446.6}$	$\frac{1}{1133}$	$\frac{1}{3205}$	1911.2896	1917.0977	$\frac{1}{330.1}$
14	1589	103	2.87	1.56	$\frac{1}{450.2}$	$\frac{1}{1145}$	$\frac{1}{3238}$	1783.8702	1789.2810	$\frac{1}{330.7}$
13	1374	71	2.91	1.57	$\frac{1}{453.2}$	$\frac{1}{1156}$	$\frac{1}{3257}$	1656.4508	1661.4675	$\frac{1}{331.2}$
12	1175	41	2.95	1.57	$\frac{1}{455.6}$	$\frac{1}{1162}$	$\frac{1}{3274}$	1529.0314	1533.6557	$\frac{1}{331.8}$
11	989	22	2.98	1.57	$\frac{1}{457.5}$	$\frac{1}{1169}$	$\frac{1}{3289}$	1401.6120	1405.8479	$\frac{1}{331.9}$
10	813	11	3.00	1.57	$\frac{1}{459}$	$\frac{1}{1174}$	$\frac{1}{3300}$	1274.1926	1278.0406	$\frac{1}{332.1}$
9	656	6	3.02	1.57	$\frac{1}{460.2}$	$\frac{1}{1179}$	$\frac{1}{3311}$	1146.7732	1150.2347	$\frac{1}{332.3}$
8	513	4	3.03	1.57	$\frac{1}{460.8}$	$\frac{1}{1182}$	$\frac{1}{3315}$	1019.3538	1022.3294	$\frac{1}{332.4}$
7	385	1	3.04	1.57	$\frac{1}{461.3}$	$\frac{1}{1183}$	$\frac{1}{3318}$	891.9344	894.6247	$\frac{1}{332.5}$
6	276	.....	3.04	....	$\frac{1}{461.9}$	$\frac{1}{1183}$	$\frac{1}{3322}$	764.5150	766.8203	$\frac{1}{332.6}$
5	186	.....	3.05	....	$\frac{1}{462.8}$	$\frac{1}{1183}$	$\frac{1}{3326}$	637.0956	639.0165	$\frac{1}{332.6}$
4	113	.....	3.05	....	$\frac{1}{462.8}$	.....	.....	.....	.....	.....
3	58	.....	3.05	....	$\frac{1}{462.8}$	.....	.....	.....	.....	.....
2	21	.....	3.05	....	$\frac{1}{462.8}$	.....	.....	.....	.....	.....
1	3	.....	3.05	....	$\frac{1}{462.8}$	.....	.....	.....	.....	.....
...	56745	56745	...	...	.....	.....	.....	.....	.....	.....

130 miles thickness must be kept intact, while the interior layers are made infinite in number. This shows that the law of compressibility is inapplicable to the crust on account of increase in temperature, while it is applicable to the interior from uniformity of temperature.

The numbers in column 2, table 4, divided by 56745 are the proportional masses composing the earth taken in thirty-one layers, the outside layer having an assumed average density of unity, or 2.96 times that of water, the mean density of the earth being 5.65 times that also of water. The other layers have masses the same as if earth were taken in layers infinitesimally thin. The numbers in column 3, divided by 56745 are the proportional masses of thirty-one ellipsoids composing the earth under conditions explained for second column. The first number in column 4 is the average density of layer 31, and the other numbers of the column taken in order are the densities at division surfaces between the layers The fractions in column 6 represent the quotients of centrifugal force divided by attraction at the surface of each layer. These results are easily attained, the one at the surface of the earth and the masses of layers being known.

Column 9 gives the polar radii of the thirty-one layers, the polar radius of the earth being about 3,950 miles.

The formulæ already developed for the attraction at the pole of any layer less, that at the equator is:

$$\text{Dif. Att.} = \frac{M}{M}\left[\tfrac{1}{5}h + \frac{6c}{5l}(H-h)\right] + \frac{2h}{M}(m + m_1 + \text{etc.}) - \frac{9}{M}(mh + m_1 n^2 h_1 + \text{etc.})$$

The values for c are given in column 5. These numbers are easily computed when the densities and the ellipticities of the layers are known. Before making Table 4, I had so unraveled its net-work by a system of assumptions and corrections that I knew to a close approximation each result. The values for l are given in column 4. M of the formulæ for the surface of any layer is found by adding numbers in column 2 from layer 1 to the layer required inclusive. *M* equals M less the sum of numbers in column 3 not inclusive of the required layer, m, m_1, m_2, etc., are given in column 3. For the surface of any layer H equals $\frac{1}{2\,9\,4}$, and for any layer from 1 to 5 *M* equals M, l equals 3.05; c, 1.57; and m, m_1, etc., are each zero. For the fifth layer the fraction for ellipticity equals that for gravity; and the fraction for gravity equals the sum for attraction and centrifugal force. For fifth layer, then,

$$g = h = \tfrac{1}{5}h + \frac{1.57 \times 6}{3.05 \times 5}(\tfrac{1}{2\,9\,4} - h) + \tfrac{1}{4\,6\,2\,8} = \tfrac{1}{3\,3\,2\,8\,6\,6}.$$

Equatorial radius $= 637.0956 \times \frac{3\,3\,2}{3\,3\,1}\frac{6}{6} = 639.0165$.

For layer sixth:

$h_1 = \frac{1}{3\,3\,2\,8\,6\,6}$, $c = 1.57$, $l = 3.04$. Assume $\frac{1}{3\,3\,2\,8\,6\,3}$ for h.

Computation now gives for attraction $\frac{1}{1182}$, $g = \frac{1}{1182} + \frac{1}{361.9} = \frac{1}{332.12}$. Average g for the layer equals a trifle less than $\frac{1}{2}$ ($\frac{1}{332.66} + \frac{1}{332.12}$ or $\frac{1}{332.39}$. Equitorial radius of sixth layer less that of fifth equals $127\,4194 \times \frac{332.4}{331.4} = 127\,8038$, or equitorial radius of sixth layer is 766.8203 miles. The polar and equitorial radii now found for sixth layer tests the assumption for ellipticity. Thus the process is continued from layer to layer in order.

For the surface of the earth, Table 4 gives attraction $\frac{1}{578}$, gravity $\frac{1}{194.8}$, and ellipticity $\frac{1}{293.3}$. It is accepted that attraction is $\frac{1}{600}$, gravity $\frac{1}{195}$ and ellipticity $\frac{1}{294}$. It is accepted also that the mean density of the earth is 5.65 times that of water, and that the surface crust density is not far from one-half of the mean. Further, it is accepted that a fluid of uniform temperature is compressed directly as applied pressure. Table 4 is made up in accordance with these known facts, making a due allowance for an increase in crust temperature. It seems reasonable, then, to accept the results of the *Tables*.

The expression already developed for the sine of the angle made by radial direction with the direction of attraction is, $\frac{6}{5}$ h n^2 m sin O cos O. Columns 8, of Tables 1, 2 and 3, gives the values for $\frac{9}{5}$ h n^2 m. From these results the direction of attraction at any point on the surface of the earth is, $.005137 \times \frac{2}{3}$ sin O cos O. When angle O becomes 45°,

$$.005137 \times \tfrac{2}{3} \text{ sin O cos O} = .001712.$$

At 45° the centrifugal force changes the direction of attraction:

$$\tfrac{1}{2} \times \tfrac{1}{289} = \tfrac{1}{578} = .001730.$$

The direction of gravity or of normal thus computed is:

$$.001712 + .001730 = .003442.$$

The direction of the normal for 45° is:

$$\tfrac{1}{294} = .003401.$$

The error is $\frac{1}{86}$, while the limit of error in the results attained by experiments for the mean density of the earth, or the ratio of surface density to mean is a fraction greater than this The tables can be adjusted to meet the discrepancy $\frac{1}{86}$, but it would add nothing to accuracy as long as the accepted results of observation are equally uncertain.

To one now doubting the theory of the geologist, I have to say in due time, I shall give him a result for the precession of the equinoxes, computed from the data of *Table* 4, agreeing with observation.

The one effect of the attraction of the sun and moon on the earth wholly liquid, is changeable figure; the other effect on the earth wholly solid, is precession of equinoxes. The effect of the attraction on the particles of a liquid or solid just filling the solid unyielding crust container is the same. To be otherwise the container must instantaneously yield to certain changes of figure due certain effects of the attraction on the particles of the enclosed liquid. In such event the container has the liquid property and from the logic of the astronomer there should be no precession.

The component of the moon's attraction that produces the ocean tides, is only a small fraction of the whole, and this component decreases to nothing at the center of the earth. The slowness of the action of this component force and the cohesion of the particles of water are such that the tide at any meridan does not appear till two hours after the moon has passed that meridan. If the tidal work was done instantaneously the tide would appear directly under the moon. A less component of attraction and a greater cohesion of particles results in slower tidal work. Such a decrease in the component attractions and such an increase in the cohesion of the particles from the surface of the earth to its center can be conceived from which the tidal effects would be wholly neutralized. It is at least evident in case of days of one hour instead of twenty-four, supposing no change of figure from change of rotation, that the ocean tides would glide to the condition of no tides as effectually as a boy slides over a thin scale of ice. The astronomer seems to have forgotten that it takes time to break ice. What is true of a water ocean and days of one hour is true of a plastic ocean and days of twenty-four hours. A crust that would be perceptibly flexible if the day were a month, might be imperceptibly so for a day of twenty-four hours. In case then, of the one hundred and twenty seven miles of solid rock crust and the plastic moulten interior what more could be reasonably expected for tides on the continents than infinitesimal vibrations.

31. The density or specific gravity of the original crust of the earth at the temperature of 0 Centigrade.

The order of evolution is from a condition of homogeneity to that of heterogeneity. To meet the results of the requisite test observations and experiments, the computations of the last article require the plastic interior of the earth to be homogeneous excepting the effect from the variation of pressure. That portion of the primitive crust not yet disintegrated by the action of water or otherwise is likewise homogeneous, and the results of the best investigations point it out to be a neutral rock, largely basic, such a rock as would be formed from the disintegrated material, not including the elements gathered in from the pristine heterogeneous atmosphere. Lyell, in speaking of trappean or volcanic rocks, says: "Abich has, therefore, proposed that we weigh these rocks in order to appreciate their composition in cases where it is impossible to separate their component minerals. Thus basalt from Staffa, containing 47.80 per cent. of silica, has a specific gravity of 2.95; whereas trachyte, which has 66 per cent. of silica, has a sp. gr. of only 2.68; trachytic porphyry, containing 69 per cent. of silica, a sp. gr of only 2.58. If we take a rock of intermediate composition, such as that prevailing at the Peak of Teneriffe, which Abich calls Trachyte-dolerite, its proportion of silica being intermediate, or 58 per cent. it weighs 2.78." On this principal a trappean rock thrown up from a depth of 38 per cent. of silica would have a specific gravity of 3.12.

For each degree Centigrade granite expands in volume .000026, marble

.000030, and French glass .000026. In using either of these fractions for primitive crust rock the margin of error is doubtless not large.

Deschanell says the compression for glass per atmosphere is about .0000029. Using for apparatus the moon and Mars instead of Oersted's Piezometer in experiment on the moon's crust and the crust of Mars, instead of on a piece of glass, I find crust rock material is compressed .0000037 per atmosphere. To one understanding the conditions, the results disagree within the limits of a good corroboration of the reliability of the apparatus.

Using for expansion .00003, and for compression .0000037, the computed temperature at 127 miles below the surface of the earth is about 3600° C. Per observations near the surface the increase in temperature is about one degree Centigrade in 90 feet, or 58 degrees in a mile. The average temperature of the crust, then, can not be far from 2500° C. The crust, then, in cooling to zero would contract about seven and one half per cent. This would make the density or specific gravity of crust rock about 3.20.

Lyell's table for "Analysis of Minerals most abundant in Volcanic and Hypogene Rocks," gives the following specific gravities: Hornblende-Faymont, in diorite, 3.20; Hornblende-Etna, in volcanic, 3.01; Uralite-Ural, 3.14; Angite-Bohemia, 3.35; Angite-Vesuvius, in lava, 3.25; Diallage-Hartz, n Gabbro, 3.23; Hypersthene-Labrador, 3.39; Bronzite-G eenland, 3.20, Olivite Carlsbod, in basalt, 3.40; Olivite-Mt. Somma, 3.33. The metals are developments from the disintegrated portion of the primitive crust. Duly considered in all directions it seems not unreasonable that crust rocks have a specific gravity of 3.20 at zero Centigrade.

32. *The interior density and temperature of the moon.*

The moon is admitted to be the direct and the only satellite offspring of the earth, and under the accepted law of its evolution, positive evidence is required to prove its component materials in like proportions, to vary from those of the earth. The mean density of the moon is about three fifths that of the earth, or 3.38 times that of water. In accordance with the method used in computing the interior density of the earth, to keep up a suitable degree of consistency and harmony with known facts, a crust or outside layer density of 3.20 must be used. If the mean density, 3.38, be a trifle small, or the surface density, 3.20, a little large, the remedy is to increase the factor .0000037 for compression, or to freeze the moon to 100 or more degrees below zero. As the factor .0000037 satisfies the conditions of Mars, that factor should not be changed. The freezing out process, then, is the only antidote. Computation gives the center density of the moon 3.52. The compression for a twenty-seven miles crust, or for about, 2,320 atmospheres, is .0086, or .0000037 per atmosphere.

It may be that the water and the air of the moon, chemically, have not yet wholly found quiet resting places, and here and there in its interior chemical action is generating heat. Doubtless, however, the moon, to the center, is solid, practically dead and colder than ice.

33. *The interior density and temperature of Mars.*

Newcomb says the mean density of Mars is 4.17 times water. Using 3.20 for the crust, the center density figures out 5.10. The compression for a fifty-six miles crust, or about 11000 atmospheres is .041, or .0000037 per atmosphere. These results are claimed to be only rough approximations. From them, nevertheless, it is doubtless safe to conclude that Mars is a solid to the center, that his interior heat has nearly all escaped and that the water and the air has been considerably absorbed in the interior of the planet.

34. *The interior temperature of the earth.*

The variation in the density of the earth from surface to center is given in Table 4. which has already been described. The conditions of this table require that the temperature of the interior layers be the same, which would be practically so in case of a moulten or liquid interior per law of convection. The compression for the one hundred and twenty-seven miles crust, or about 60000 atmosphere on the interior at temperature zero, should be .0000037 multiplied by 60000, or .222. The compression for the same crust of the earth in its presents condition given in Table 4 is only .11, or computed to three decimal places is .114. The difference .108 is caused by internal heat. This difference, .108 divided by .00003 gives the interior temperature to be 3600° Centigrade.

34. Interior density and temperature of Venus.

Newcomb gives 4.81 for the mean density of Venus, and 7,660 miles for her mean diameter or 258 miles less than the mean diameter of the earth, On the hypothesis that Venus has a moulten interior and a crust about the thickness of that of the earth, by using 3 for the crust density we get the required mass into the planet with a center density of 7, and a crust compression factor of .0913. The compression for one hundred and twenty three miles crust or about 49,000 atmospheres is at temperature zero .1813. The difference between .1813 and .0913 divided by .00003 gives for the interior temperature of Venus 3000° Centigrade. Per Newcomb the gravity on the surface of Venus is .82, Mars .39, Earth 1.

35. *The interior density and temperature of Mercury.*

Mercury has a mean density, per Newcomb, 6.85, and a diameter of about 3000 miles, and also a surface gravity .46. The Moon's diameter is 2160 miles, mean density 3.33. crust density 3.20 and center density 3.52. Mars diameter is 4211 miles, mean density 3.17, surface density 3.20, center density 5.10, and surface gravity .39.

Without computation judging by a glance from the figures from the Moon and Mars, the crust density of Mercury must be from 5 to 5.50. Proctor thinks that 6.85 is too great for the mean density, and that it should be about that of the earth, 5.67. Under this condition Mercury's crust density would be from 4 to 4.30. The smallness of the diameter of this planet indicates that its interior heat has all or nearly all escaped. In

case its interior heat has not escaped the figures above given for crust density must be made larger.

36. The crust density of Jupiter's satellites.

The diameters of Jupiter's satellites in orders of Nos. per Loomis is in miles, 2436, 2187, 3576 and 3057. There is some uncertainty about these diameters, and Newcomb says they vary from 2200 to 3700 miles. The mean densities of these satellites in order, per diameters of Loomis is, 1.05, 1.90, 1.70 and 1.32. The averages of these mean densities is 1.49, or a little more than the mean density of Jupiter, which is 1.33. The surface gravity of these satellites is very small, hence the center density can not be very much greater han the crust density. The average crust density can not vary much from 1.30.

37. As already obtained, the near surface or crust density of Mercury is about 5, Venus at present average temperature, 3, or at zero 3.20, the Earth at present average temperature, 2.96, or at zero 3.20, the Moon at zero 3.20, Mars at zero 3.20, and the average of Jupiter's satellites 1.20. From these results I see away back in the past a large ring around the sun; this ring separated into three, like the rings now around Saturn; and from these three came the triplet planets, Mars, the Earth and Venus.*

CONCLUSION.

During the delay of two years in the publication of this Report of the Academy of Sciences, Arts and Letters, I have added three chapters to this paper. As it stands the title is inappropriate, and the introduction fails to give due credit to the paper as presented. *The Attraction and the Figure of Equilibrium of a Rotating Fluid Mass, and the Interior Density and Temperature of the Earth,* is a more appropriate title. Measured by my reading of what has been written on the subject, this investigation attains not only some new final results, but it opens, by its new methods, a new field for valuable deductions. The new way of finding any diameter of the ellipse is a change from the complex to the simple. The system using chord and wedge elements of attraction instead of shell elements is a grand step of advance in simplification. By the new system mathe-

* It is due the author to say that the chapters of this paper were written at periods separated by months. The last chapter was composed after the previous ones had passed from his hands, and he was forced to keep up the connection with the other chapters, partially from memory. His excuse for not unifying the paper under an appropriate title is want of time.

matical expressions are attainable, easy to integrate, while by the old method complex expression are unavoidable, requiring the ability of a Legendre, a Laplace, or an Ivory to integrate.

In Article 12 I have given the fractional numbers for integrating the chord elements of attraction for an ellipsoid. If every man and women, from Adam and Eve to the last born of their posterity, had been engaged in the work of making the computations for these fractional numbers by the method outlined in Article 12, the end in view would now be unattained. Such being the impossibility in the way of that method, I will now give my other method in brief. It is as follows:

In diagram 1, Art. 3, let particle P be at the surface of the sphere having center C, in line P C of the diagram, then secant line P d a g becomes chord P a g and equals to chord k l h or $2\,r\cos\vartheta$. Likewise chord p n o equals $2\,r\cos\vartheta$. Let radius A C perpendicular to the axis of rotation be divided into n parts by a system of chords drawn parallel to axis P C, and also let these chords vary in length from chord to chord by a common difference 2 r divided by n. Let lines p n o and k l h be any two adjoining chords of the system. The mass cut from the sphere by a rotation of these chords equals $\frac{4}{3}\,\pi\,r^3\,(\cos^3\vartheta - \cos^3\vartheta_1)$. As the increments to the cosines used in this computation vary from cos. to cos. as 2 r divided by n, cos. ϑ may be represented by any simple variable quantity (y). When n becomes infinite or 2 r divided by n, infinitisimal, then the differential mass or,

$$dm = \tfrac{4}{3}\,\pi\,r^3\,3\,y^2\,dy.$$

Multiply each chord element of mass making up the sphere by its requisite $\cos\vartheta$, $\cos^2\vartheta$, $\cos^3\vartheta$, and so on to cos. having an exponent infinite. It is now required to intigrate the expressions $y\,dm$, $y^2\,dm$, $y^3\,dm$, etc., between the limits zero and unity.

$$\int_0^1 y\,dm = \tfrac{4}{3}\,\pi\,r^3 \int_0^1 3\,y^3\,dy = \tfrac{4}{3}\,\pi\,r^3 \times \tfrac{3}{4}.$$

$$\int_0^1 y^2\,dm = \tfrac{4}{3}\,\pi\,r^3 \int_0^1 3\,y^4\,dy = \tfrac{4}{3}\,\pi\,r^3 \times \tfrac{3}{5}.$$

$$\int_0^1 y^3\,dm = \tfrac{4}{3}\,\pi\,r^3 \int_0^1 3\,y^5\,dy = \tfrac{4}{3}\,\pi\,r^3 \times \tfrac{3}{6}.$$

Etc., to exponent infinite.

$\frac{4}{3}\pi r^3$ represents the mass of the whole sphere. The values, then, for

Cos. $\vartheta = \frac{3}{4}$.
Cos.^{2} $\vartheta = \frac{3}{5}$.
Cos.^{3} $\vartheta = \frac{3}{6}$, etc., to cos. with exponent infinite.

$\text{Sin}^2\vartheta = 1 - \cos^2\vartheta = \frac{2}{5}$.
$\text{Sin}^4\vartheta = (1 - \cos^2\vartheta)^2 = 1 - 2\cos^2\vartheta + \cos^4\vartheta = \frac{2}{5}\frac{4}{7}$.
$\text{Sin}^6\vartheta = (1 - \cos^2\vartheta)^4 = 1 - 4\cos^2\vartheta + 6\cos^4\vartheta - 4\cos^6\vartheta + \cos^8\vartheta = \frac{2}{5}\frac{4}{7}\frac{6}{9}$,

Etc. for higher powers.

The truth contained in the celebrated proposition of the square of the hypothenuse was doubtless well known long before the time of Pythagoras. Pythagoras in joy from the simplicity and the exactness of his demonstration of the celebrated proposition gave exclamation to the Greek word, *Eureka.* The memoirs of Legendre, Laplace and Ivory on *attraction* do not contain *Eureka* demonstrations. It requires inventive genius as well as mathematical ability to make such demonstrations. For borrowed knowledge on the subject of my writing to Sir Isaac Newton, I am indebted more by far than to all the rest combined.

Genera of the Family Attidae:

WITH A PARTIAL SYNONYMY.

BY

GEORGE W. AND ELIZABETH G. PECKHAM.

INTRODUCTION.

In the following paper we have endeavored to bring together the definitions of those genera of the family Attidae which have been generally received, and also of those which are part of the synonymy of the received genera. Up to this time these definitions have been so widely scattered through different works and periodicals that it has been a matter of great practical inconvenience to study and to compare them. It is probably due, in a measure, to this fact that many species have been placed in genera from which a moderate regard for the generic definitions would have excluded them; although perhaps a further difficulty may have arisen from a confusion of the two modes of classification, the one based on a type, and the other based on a general definition. To make clear the distinction between these two modes, we quote from Whewell[1], "Natural groups given by type, not by definition . . . . . the class is steadily fixed, though not precisely limited; it is given, though not circumscribed: it is determined, not by a boundary line without, but by a central point within; not by what it strictly excludes, but by what it eminently includes; by an example, not by a precept; in short, instead of a definition we have a *type* for our director. A type is an example of any class, for instance, a species of a genus, which is considered as eminently possessing the character of the class. All the species which have a greater affinity with this type-species than with any other, form the genus and are ranged about it, deviating from it in various directions and different degrees." On the other side we have from Mill:[2] " . . . . . the next step is to ar-

[1] The Philosophy of the Inductive Sciences, Vol. 1, pp. 476, 477.

[2] A System of Logic, pp. 504, 505. Huxley, also says: "It is said, in short, that a natural history class is not capable of being defined — that the class Rosaceæ for instance, or the class Fishes, is not accurately and

range those *infimae species* into larger groups . . . . . and in doing this it is true that we are naturally and properly guided, in most cases at least, by resemblance to a type. . . . . But though the groups are suggested by types, I cannot think that the group, when formed, is *determined* by the type; that in deciding whether a species belongs to the group, a reference is made to the type and not to the characters. . . . . The truth is, on the contrary, that every genus or family is framed with distinct reference to certain characters, and is composed, first and primarily, of species which agree in possessing all those characters. To these are added, as a sort of appendix, such other species, generally in small number, as possess *nearly* all the properties selected; wanting some of them one property, some another, and which, while they agree with the rest *almost* as much as those agree with one another, do not resemble in an equal degree any other group. Our conception of the class continues to be grounded on the characters; and the class might be defined, those things which *either* possess that set of characters, *or* resemble the things that do so, more than they resemble anything else. And this resemblance itself is not, like resemblance between simple sensations, an ultimate fact unsusceptible of analysis. Even the inferior degree of resemblance is created by the possession of common characters. . . . . *Nor can there be any real difficulty in representing, by an enumeration of characters,* the nature and degree of the resemblance which is strictly sufficient to include any object in the class. There

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absolutely definable, inasmuch as its members will present exceptions to every possible definition; and that the members of the class are united together only by the circumstance that they are all more like some imaginary average race or average fish, than they resemble anything else. But here, as before, I think the distinction has arisen entirely from confusing a transitory imperfection with an essential character. So long as our information concerning them is imperfect, we class all objects together according to resemblances we *feel*, but cannot *define*; we group them around *types*, in short. Thus, if you ask an ordinary person what kind of animals there are, he will probably say beasts, birds, reptiles, fishes, insects, etc. Ask him to define a beast from a reptile and he cannot do it; but he says, things like a cow or a horse are beasts, and things like a frog or a

are always some properties common to all things which are included. Others there often are, to which some things, which are nevertheless included, are exceptions. But the objects which are exceptions to one character are not exceptions to another; the resemblance which fails in some particulars, must be made up for in others. The class, therefore, is constituted by the possession of *all the characters which are universal,* and *most* of those which admit of exceptions. If a plant had the ovules erect, the stigmata divided, possessed the albumen, and was without stipules, it possibly would not be classed among the Rosaceæ. But it may want any one, or more than one, of these characters, and not be excluded. The ends of a scientific classification are better answered by including it. Since it agrees so nearly, in its known properties, with the sum of the characters of the class, it is likely to resemble that class more than any other in those of its properties which are still undiscovered."

A further confusion has arisen from certain authors making their generic definitions descriptive rather than comparative. For example, the definition of the genus Maratus Karsch is doubtless a good description, so far as it goes, of the species for which the genus was formed, and yet is equally applicable to many other genera, and in no way assists in organizing knowledge, nor in facilitating identification, which should be the two-fold purpose of a classification.

The synonymy of the genera is only partial; and those who have had most experience in the difficulties of this

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lizard are reptiles. You see *he does* class by type, and not by definition. But how does this classification differ from that of the scientific zoologist? how does the meaning of the scientific class-name of "Mammalia" differ from the unscientific of "Beasts?" Why, exactly because the former depends on a definition, the latter on a type. The class Mammalia is scientifically defined as "all animals which have a vertebrated skeleton and suckle their young." Here is no reference to type, but a definition rigorous enough for a geometrician, and such is the character which every scientific naturalist recognizes as that to which his classes must aspire — knowing, as he does, that classification by type is simply an acknowledgment of ignorance and a temporary device." Educational Value of Natural History Sciences; Lay Sermons, Addresses and Reviews, pp. 82, 83.

class of work will be least harsh in their criticism of its defects.

The key is based almost entirely on the generic descriptions, and is designed not only to aid in the identification of genera, but also, in a general way, to group together those genera which have common characteristics, and thus to aid in a comparison of the different groups. Its usefulness must be lessened by the fact that the generic position of a species has been commonly determined merely by its possessing a greater number of the characteristics of one genus than of any other. For example: Cyrba Simon has legs 4, 1, 3, 2. The greater number of characteristics of C. bi-maculatu Keyserling carry that species to the genus Cyrba, although it has the leg-formula 4, 3, 1, 2. If in the key Cyrba has been distinguished from other genera by the fact that its leg-formula is 4, 1, 3, 2, bi-maculata must go elsewhere.

We have also, for the purpose of facilitating comparison, arranged the characteristics of the different genera in the form of a table.

We have been perplexed by a lack of precision in the stating of characteristics. We venture to suggest that it would be well to express the dimensions of parts in terms of other parts of the same species. For example, the clypeus should be described not as "very low," or "rather high," but as one fifth or one half as wide as the middle anterior eyes. We believe that Menge is the only author who states definitely the height of the cephalothorax. He does so by comparing the height with the width.

Not having the work in which it is described, we have omitted the genus Portia Karsch. In his Arachnol. Blätter V. Zur Attiden-Gattung Portia, Dr. Karsch says that this genus resembles Eris (C. Koch) Simon, but differs from it in that the first pair of legs is not much more robust than the others; metatarsus + tarsus of the fourth are longer than patella + tibia of fourth, not equal or shorter as in Eris); and the spines on the tibiae and metatarsi of the hind legs extend to the base. The quadrangle of the eyes, also, is not wider behind than in front.

As we have undertaken to prepare a monograph of this

family, we shall be very glad to receive Attidae from any part of the world, and to send in return spiders of the United States.

We give below a brief account of the Attid genera.

Milwaukee, Wisconsin, March, 1884.

THE ATTID GENERA.

From Latreille to Walckener, inclusively, the whole family constitutes but one genus, Salticus Latr. or Attus Walck. In 1832 Hentz detached the genera Lyssomanes, Synemosyna, and Epiblemum; Lyssomanes having the eyes in four rows; Synemosyna corresponding in part to Salticus (Latr.) C. Koch, or Leptorchestes Thorell, 1870; and Epiblemum in part to Calliethera C. Koch, 1837. In 1833 Sundevall divided Attus Walck. into two genera, Salticus and Attus. Salticus having the cephalic abruptly higher than the thoracic part, and the quadrangle of the eyes nearly square. Between 1833 and 1850 twenty-four genera were formed by C. Koch, most of which were so poorly defined by their author that their identification has been difficult or impossible. These genera, however, have been used as a basis of work by later authors who have redefined and united them, so that eighteen out of Koch's twenty-four genera are still used, beside some of his sub-genera which have been raised to the rank of genera by Thorell. A short history of C. Koch's genera would run as follows: Heliophanus, 1833; Euophrys, 1834; Dendryphantes, 1837; Pyrophorus, 1837; (the name Pyrophorus had already been used, and the genus was identical with Salticus (Latr.) Sund., 1833); Toxeus, 1846; (probably also included in Salticus (Latr.) Sund.; Janus, 1846; (the name Janus was preoccupied; the genus is in part Synemosyna Hentz, 1832, and in part Janigena Karsch, 1880); Philia, 1846, (the name Philia was preoccupied, and for it Thorell substituted, Philæus in 1870); Hyllus, 1846; (identical with Dineresus White, formed in the same year); Thiania, 1846; Marpissa, 1846; (the name Marpissa was preoccupied;

Thorell substituted Marptusa in 1877); Cocalus, 1846; Plexippus, 1846; Phidippus, 1846; Amycus, 1846; Alcmena, 1846; Asaracus, 1846; (this genus, without any striking characteristic, and formed for one imperfect individual, has never been used); Phyale, 1846; Eris, 1846; Ciris, 1848; Mævia, 1848; Rhanis, 1848 (identical with Homalattus White, 1841); Psecas, 1850; (this vaguely characterized genus has not been adopted by later authors); Icelus, 1850; (the name Icelus being preoccupied Simon substituted Icius in 1873); Ballus, 1850; (this was a sub-genus of Attus, made a genus by Thorell in 1870); Dia and Parthenia, two sub-genera of the genus Euophrys, were combined and made a genus with the name Ælurops (both Dia and Parthenia being preoccupied) by Thorell also in 1870.

During this period only one author, beside Koch, made any genera in the family Attidae. This was A. White, who, in 1841, made Homalattus; and in 1846 Dineresus, of which Hyllus C. Koch, takes precedence; and after 1850 no new genera were formed for many years. Of Westring and Blackwall, both writing in 1861, the former followed Sundevall's division (1833), into Salticus and Attus, while the latter used only Salticus Latr. unmodified. In 1864, Simon combined the Attid genera to form five: Rhanis C. Koch, Attus Walck, Cyrtonota Sim., Heliophanus C. Koch, and Salticus (Latr.) This arrangement, which was not generally adopted, seems not to have satisfied its author, as in 1869, Simon made an entirely new classification of the Attidae, recombining them into ten genera of which two, Menemerus and Yllenus were new.

We now come to 1870, in which year Thorell published the first part of his work on the genera and species of European spiders, probably the most important contribution thus far offered to arachnological literature in the department of classification. In so far as the Attidae are concerned his most valuable work was the unravelling of C. Koch's European genera. He resolved the family into thirteen provisional genera, one of which, Leptorchestes, was new. He also formed the genus Diolenius for the species A. phrynoides Walck.; and he made the changes in the

nomenclature of some of C. Koch's genera which have already been mentioned.

In 1871, the genus Hasarius was formed by Simon. In 1872, Taczanowski described a new genus, Jelskia, which he placed under the family Dinopidae, but which seems to us to belong to the Attidae, since although the eyes are in four rows, (as in Lyssomanes Hentz), the eyes of the third row, are small, not as in the Dinopidae, larger than the others. In 1873 Simon substituted the name Icius for Icelus C. Koch.

In 1876, Simon modified his classification of the Attid genera, and succeeded in making an arrangement so good that as Dr. L. Koch remarks, it will form the basis for all future work. The new genera which he formed in this year were Synagles, Neera, Neon, Hyctia, Thya, Saitis, Pellenes, Habrocestum, Cyrba and Phlegra.

In 1877, Thorell made the genera Agorius and Viciria, and substituted the name Marptusa for Marpissa C. Koch. In the same year Simon formed the genus Bavia, and Simon and Cambridge each described a genus having the eyes in four rows; these are Evenus Simon, and Athamas Cambridge. Also in 1877, the genera Oedipus and Scartes were formed by Menge.

In 1878, Thorell formed the genera Boethus and Sinis; Karsch, the genera Lycidas, Ligonipes, Ligurinus, Maratus, Ascyltus and Mopsus; and Taczanowski, the genus Chirothecia.

In 1879, L. Koch formed the genera Astia, Scirtetes, Rhombonotus, Scaea, and Lagnus, and in 1880, Opisthoncus. In 1880, also, we have the genus Janigena Karsch. In 1881, Keyserling formed Jotus, and Ergane, and Thorell, Simaetha, Discocnemius, Ephippus, Euryattus, Omoedus and Coccorchestes.

In 1882, Keyserling formed Thorellia (which afterwards proved to be identical with Saitis Simon), Eulabes, Tanypus, Acmaea (these three names being preoccupied they were afterward supplanted, Eulabes by Pirithous, Tanypus by Sinnamora, and Acmaea by Drepanephora); Morgaromma, Erasmia, Sobara, Selaophora, Prostheclina, Cytaea, Atry-

tone, Hadrosoma and Therosa; and Cambridge formed the genus Mago. This latter author, who has described a large number of species, has, with a few exceptions, included them all in the genus Salticus Latr.

In 1883, Keyserling formed the genera Lauharulla, Scythropa and Sandalodes, and substituted the names Pirithous, Sinnamora, and Drepanephora for Eulabes, Tanypus, and Acmaea.

In 1884 Simon formed the genera Mithion, Lystrocteisa and Chalcolecta.

Finding that several generic names now in use are preoccupied we make the following substitutions:

For Evenus Simon 1877, "Epeus." (Evenus Hübu. Lep. 1816. Agassiz' Nomencl. Zool. Evenus Lap. Col. 1836. Agassiz' Nomencl. Zool.)

For Sinis Thorell 1878, "Linus." (Sinis Heer. Col. 1862. Scudder's Nomencl. Zool.)

For Scirtetes L. K. 1879, "Damoetas." (Scirtetes Wagn. Mamm. 1841. Agassiz' Nomencl. Zool.)

For Ephippus Thorell 1881, "Zenodorus." (Ephippus Cuv. Pisc. 1829. Agassiz' Nomencl. Zool.)

For Erasmia Keyserling 1882, "Iona." (Erasmia Hope. Lep. 1840, Agassiz' Nomencl, Zool. Erasmia Heine. Aves 1863. Scudder's Nomencl. Zool.)

For Atrytone Keyserling 1882, "Tara." (Atrytone Scud. Lep. 1872. Zool. Record.)

For Hadrosoma Keyserling 1882, "Bootes." (Hadrosoma Fieb. Orth. 1853. Scudder's Nomencl. Zool.)

For Scythropa Keyserling 1883, "Bianor." (Scythropa Chand. Col. 1871. Zool. Record.)

For Drepanephora Keyserling 1883, "Hypoblemum." (Drepanephora Loew. Dipt. 1869. Zool. Record.)

We divide the family Attidae into two sub-families, the Attinae, having the eyes in three rows, and the Lysomanae, having the eyes in four rows.

KEY TO THE GENERA OF THE FAMILY ATTIDAE.[1]

1. Eyes in three rows 3
2. Eyes in four rows 161
3. [2]Trochanter I elongated much longer than the others 5
4. Trochanter I not elongated 13
5. Trochanter I much longer than coxa, shorter than femur 7
6. Trochanter I shorter than coxa (especially ♀), much shorter than femur 9
7. Cephalothorax low; quadrangle of eyes wider than long: tibia I slender and parallel ..... [3]**Tara Peckham.**
8. Cephalothorax rather high; quadrangle of eyes almost equal in length and breadth; tibia I more or less dilated .... **Diolenius Thor.**
9. Quadrangle of eyes much longer than wide, and much longer than thoracic part; eyes of second row much nearer lateral than dorsal eyes ... . **Lystrocteisa E. S.**
10. Quadrangle of eyes almost equal in length and breadth; thoracic and cephalic parts almost equally long; eyes of second row scarcely further from dorsal than from lateral 11
11. Legs short; anterior tibia strongly compressed and dilated, and conspicuously furnished below with two rows of strong spines, and in the middle line with thick hairs..... **Discocnemius Thor.**
12. Legs long; anterior tibia compressed, parallel, not dilated; armed below with numerous and strong spines in a double row. **Chalcolecta E. S.**
13. Cephalothorax distinctly wider in the middle than at the ends. **Rhombonotus, L. K.**
14. Cephalothorax not distinctly wider in the middle than at the ends 15
15. Body slender, antlike; legs weak..... 17
16. Body not antlike in form..... 29
17. Cephalic part higher than thoracic.....**Salticus Latr.**
18. Cephalic part not higher than thoracic..... 19
19. Abdomen with a distinct constriction..... 21
20. Abdomen without, or with a very slight constriction..... 23
21. Cephalic and thoracic parts separated by a constriction. **Janigena Karsch.**

[1] On account of the vagueness of their definitions, we have been obliged to omit from the Key the genera Phyale, Asaracus, Alcmena, Psecas, and Thiania of C. Koch, and Lycidas, Ligurinus, and Maratus Karsch.

[2] We have here made use of the table given by M. Simon in his *Note sur le Groupe des Diolenii.* This group, so far as is yet known, is confined to Australian and Malesian islands.

[3] Tara = Atrytone Keyserling, preoccupied.

22. A constriction dividing the thoracic part into a shorter anterior and a longer posterior portion.....**Synemosyna Hentz.**
23. Sternum prolonged between coxae I..... 25
24. Sternum not prolonged between coxae I.....**Agorius Thor.**
25. Pedicle of the abdomen not visible from above..[1]**Damoetas Peckham.**
26. Pedicle visible from above..... 27
27. Sternum scarcely as wide as intermediate coxae; labium at least twice as long as wide .....**Leptorchestes Thor.**
28. Sternum wider than intermediate coxae; labium as long as wide. **Synageles F. S.**
29. Clypeus very low in front, high below anterior lateral eyes, extended and a little curved backward on the sides, forming an acute angle below the eyes of the second row....**Ascyltus Karsch.**
30. Sides of clypeus forming no acute angle..... 31
31. Body short, convex, beetle like; cephalic part not, or scarcely so long as thoracic... 33
32. Body not beetle like in form[2]..... 35
33. Body strongly convex both longitudinally and transversely; abdomen high and widely truncated in front, where it is received into an excavation of the cephalothorax; eyes of the second row further from the dorsal than from the lateral eyes. **Coccorchestes Thor.**
34. Anterior part of abdomen not overlapped by cephalothorax; eyes of second row half way between dorsal and lateral eyes. **Omoedus Thor.**
35. Cephalic part as long as, or longer than thoracic 37
36. Cephalic part shorter than thoracic 61
37. Eyes of the second row at least half as large as eyes of the third row .....**Cocalus C. K.**
38. Eyes of second row less than one half as large as eyes of the third row..... 39
39. Quadrangle of eyes longer than wide; tibia I greatly dilated. **Chirothecia Tacz.**
40. Quadrangle as wide as, or wider than long; tibia I not dilated.... 41
41. Cephalic and thoracic parts equal..... 43
42. Cephalic part longer than thoracic..... 55
43. Legs III and IV without spines.....**Ballus C. K.**
44. Spines on the four pairs..... 45
45. Third leg longer than fourth..... ... 47
46. Third leg shorter than fourth 49

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[1] Damoetas=Scirtetes L. K., preoccupied.

[2] Some of the species of Homalattus White resemble beetles, but in this genus the cephalic part is longer than the thoracic.

47. Quadrangle of the eyes wider behind: third leg much longer than fourth.....[1]**Neaetha E. S.**
48. Quadrangle of eyes wider in front; third leg but little longer than fourth.....**Ciris C. K.**
49. Cephalothorax not wider than third row of eyes at that place ... 51
50. Cephalothorax wider than third row of eyes at that place; lateral eyes of first row well separated from middle eyes...**Pirithous Keys.**
51. Anterior row of eyes curved; lateral widely separated from middle eyes 53
52. Anterior row of eyes almost straight; lateral but little removed from middle eyes.....[2] **Bianor Peckham.**
53. Quadrangle of eyes equally wide in front and behind: metatarsus + tarsus IV longer than patella + tibia; tibial and metatarsal spines to the base, on legs III and IV..... **Portia Karsch.**
54. Quadrangle of eyes wider behind than in front; metatarsus + tarsus IV, equal to or shorter than patella + tibia; only circles of spines at the extremities of the tibiae and metatarsi of legs III and IV..... **Eris, C. K.**
55. Quadrangle of eyes wider in front than behind.....[3] **Iona Peckham.**
56. Quadrangle of eyes not wider in front 57
57. Cephalothorax as high behind as it is long .....**Mago Cambridge.**
58. Cephalothorax not as high behind as long 59
59. First row of eyes straight, touching.....**Neon E. S.**
60. First row of eyes curved, separated by nearly equal distances from each other.....**Homalattus White.**
61. Quadrangle of eyes longer than wide 63
62. Quadrangle of eyes wider than long..... 65
63. Quadrangle of eyes more than twice as long as wide..
Ligonipes Karsch.
64. Quadrangle of eyes one fourth or one fifth only longer than wide..... .....[4]**Plexippus C. K.**
65. A more or less prominent tubercle between the dorsal eyes.
Opisthoncus L. K.
66. No tubercle present..... 67
67. Cephalothorax short and very high, thoracic part much dilated and falling steeply from cephalic plate; cephalothorax wider than the third row of eyes..... .....[5]**Amycus C. K.**
68. Form of cephalothorax unlike the above 69
69. Quadrangle of eyes wider in front than behind..... 71

[1] Neaetha=Neea E. S., preoccupied.

[2] Bianor = Scythropa Keyserling, preoccupied.

[3] Iona = Erasmia Keyserling, preoccupied.

[4] See genus Plexippus.

[5] The face in Amycus is very high, but not equally high in the different species.

70. Quadrangle as wide or wider behind..... 91
71. Tibia + patella III shorter than tibia + patella IV..... 73
72. Tibia + patella III longer than tibia + patella IV..... 81
73. Metatarsus + tarsus IV equal to or shorter than patella + tibia IV. 75
74. Metatarsus + tarsus IV longer than tibia + patella IV..... 77
75. Metatarsus IV spined only at extremity .....**Lauharulla Keys.**
76. Metatarsus IV spined to base..... .....**Astia L. K.**
77. Cephalothorax wider than third row of eyes 79
78. Cephalothorax not wider than third row of eyes....**Sinnamora Keys.**
79. Legs moderately long; metatarsus IV with spines.....**Boethus Thor.**
80. Legs extremely long; metatarsus IV without spines .....**Lagnus L. K.**
81. Eyes of the second row more than $\frac{1}{3}$ as large as dorsal eyes; tibiæ spined above ....[1] **Linus Peckham.**
82. Eyes of second row less than $\frac{1}{3}$ as large as dorsal eyes; tibiæ not not spined above..... 83
83. Cephalothorax not wider than third row of eyes 85
84. Cephalothorax wider than third row of eyes 87
85. Cephalothorax narrow in front, wider and rounded behind; quadrangle of eyes scarcely wider than long .....**Prostheclina Keys.**
86. Cephalothorax with sides nearly parallel; quadrangle of eyes one-third wider than long .....**Saitis E. S.**
87. Abdomen very long and slender, much longer than cephalothorax; cephalothorax much wider than third row of eyes ...**Viciria Thor.**
88. Abdomen rather short; cephalothorax but little wider than third row of eyes 89
89. Abdomen about as wide as long; eyes of second row further from lateral than from dorsal eyes .....**Margaromma Keys.**
90. Abdomen slender; eyes of second row half way between lateral and dorsal eyes.....**Therosa Keys.**
91. Quadrangle of eyes equally wide in front and behind; tibia + patella III longer than tibia + patella IV..... 93
92. Quadrangle of eyes wider behind; or equally wide in front and behind, with tibia + patella III equal to, or shorter than tibia + patella IV..... 99
93. Eyes of the third row distant by at least double their diameter from the margin of the cephalothorax .....[2] **Zenodorus Peckham.**
94. Eyes of the third row not, or only a little removed from the margin of the cephalothorax 95
95. Metatarsus + tarsus IV equal to, or shorter than, tibia + patella IV..... 97
96. Metatarsus + tarsus IV longer than tibia + patella IV.
Ergane Keys.

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[1] Linus = Sinis Thorell, preoccupied.

[2] Zenodorus=Ephippus Thorell, preoccupied.

97. Legs III and IV nearly equal; eyes of third row further from each other than from lateral borders; anterior lateral well separated from large middle eyes.....**Cytaea Keys.**
98. Third legs longer than fourth : eyes of third row equally far from each other and from lateral borders ; anterior lateral very near large middle eyes.....**Habrocestum E. S.**
99. Quadrangle of eyes equally wide in front and behind; anterior row of eyes straight..... 101
100. Quadrangle wider behind; or, if equally wide in front and behind, anterior row curved..... 117
101. Coxae I touching.. .....**Hyctia E. S.**
102. Coxae I separated by width of labium..... 103
103. Tibia IV as large as patella at base, cylindrical, parallel or a little enlarged at extremity..... 105
104. Tibia IV narrower than patella at base ; slightly enlarged and a little compressed at extremity..... 109
105. Quadrangle of eyes as long as wide ; fore central eyes excessively large, at least five times as large as the lateral.....**Mithion E. S.**
106. Quadrangle of eyes wider than long ; fore central eyes not excessively large..... 107
107. Thoracic part a little dilated; coxæ IV longest.....**Menemerus E. S.**
108. Thoracic part parallel; coxæ I largest.....**Bavia E. S.**
109. Patella III as long as or longer than patella IV; tibia III much shorter than tibia IV, but more robust..... 111
110. Patella III shorter than Patella IV; tibia III more slender than tibia IV..... 113
111. Clypeus at least $\frac{1}{3}$ as wide as large middle eyes; patellae always without spines..... .....**Euophrys C. K.**
112. Clypeus very narrow, scarcely $\frac{1}{5}$ as wide as large middle eyes; patellae armed with two spines ....**Cyrba E. S.**
113. Sternum wider than intermediate coxae; (♂) femur of palpus armed with a strong apophysis..... **Heliophanus C. K.**
114. Sternum of same width or narrower than intermediate coxae; femur of palpus unarmed..... 115
115. Thoracic part twice as long as cephalic.....**Phlegra. E. S.**
116. Thoracic part only $\frac{1}{3}$ longer than cephalic.....**Attus Walck**
117. Quadrangle of eyes equally wide in front and behind..... 119
118. Quadrangle of eyes wider behind..... 133
119. Anterior row of eyes strongly curved, a straight line from the summit of the middle eyes cutting the lateral eyes through, or below the middle.....**Scaea C. K.**
120. Anterior row of eyes slightly curved, a straight line from summit of middle eyes cutting lateral eyes above the middle..... 121
121. Legs without femoral and tibial spines; (♂) falces long and horizontal.....**Epiblemum Hentz**

122. Legs having femoral and tibial spines on the four pairs..... 123
123. Eyes of the third row nearer to each other than to lateral borders.....**Maevia E. S.**
124. Eyes of the third row equally distant from lateral borders and from each other..... 125
125. Eyes of the second row nearer the dorsal than the lateral eyes, [1] **Selaophora Keys.**
126. Eyes of second row half-way between dorsal and lateral eyes, or nearer the lateral..... 127
127. Cephalothorax only $\frac{1}{6}$ larger than wide; scarcely wider than third row of eyes; first legs not stouter than the others, [1] **Bootes Peckham.**
128. Cephalothorax at least $\frac{1}{5}$ longer than wide; first legs stouter than the others..... 129
129. Cephalothorax considerably wider than third row of eyes; moderately high..... 131
130. Cephalothorax only slightly wider than third row of eyes; very high and convex.....**Jotus Keys.**
131. Second row of eyes half-way between dorsal and lateral eyes; falces not diverging.....**Sandalodes Keys.**
132. Second row of eyes nearer the lateral than the dorsal eyes; falces diverging..... **Hyllus C. K.**
133. Anterior row of eyes very strongly curved, a straight line from the summit of the middle eyes cutting only the lower borders of the lateral eyes.....[2] **Ælurillus E. S**
134. Anterior row of eyes straight or only moderately curved, a straight line from the summit of the middle eyes cutting the lateral eyes not below the middle..... 135
135. Clypeus as wide as large middle eyes..... 137
136. Clypeus not so wide as large middle eyes..... 139
137. Cephalothorax as wide as or barely narrower than long. **Sobara Keys.**
138. Cephalothorax at least $\frac{1}{3}$ longer than wide.....**Mopsus Karsch.**
139. Tibia + patella III shorter than tibia + patella IV 141
140. Tibia + patella III as long as or longer than tibia + patella IV .. 153
141. Coxae I separated by width of labium at base..... 145
142. Coxae I touching or nearly touching..... 143
143. Cephalothorax short, high, convex; relative length of legs 1, 4, 2, 3; abdomen short.....**Simaetha Thor.**
144. Cephalothorax elongated, flattened; relative length of legs 1, 2, 3, 4; abdomen long .....**Marptusa Thor.**
145. Trochanter IV very long, diverging, visible from above; tarus and metatarus IV as thick as tibia and patella .....**Yllenus E. S.**

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[1] Bootes=Hadrosoma Keyserling, preoccupied.

[2] Ælurillus=Aelurops Thorell, preoccupied.

146. Trochanter IV short, not visible from above; metatarsus and tarsus IV more slender than tibia and patella 147
147. Metatarsus IV having only a circle of spines at extremity (sometimes lacking these)..... 149
148. Metatarsus IV armed to base 151
149. Anterior row of eyes rather strongly curved; legs very hairy, **Dendryphantes C. K.**
150. Anterior row of legs straight or almost straight; legs almost glabrous..... **Icius E. S.**
151. Eyes of second row double as far from dorsal as from lateral eyes..... **Phidippus C. K.**
152. Eyes of second row almost half-way between dorsal and lateral eyes..... **Philaeus Thor.**
153. Interval between lateral and middle eyes of first row as wide or nearly as wide as the diameter of the lateral..... 155
154. Lateral separated by a space not more than ½ as wide as their diameter from the middle eyes..... 157
155. Cephalothorax dilated toward the front; clypeus very low, less than ¼ as wide as the laree middle eyes ..... **Euryattus Thor.**
156. Cephalothorax with thoracic part very strongly dilated; clypeus about ½ as wide as large middle eyes..... [1]**Thyene E. S.**
157. Metatarsus + tarsus IV equal to tibia + patella IV 159
158. Metatarsus + tarsus IV shorter than tibia + patella IV. **Pellenes E. S.**
159. Second legs longer than the first ..... [2]**Hypoblemum Peckham.**
160. First legs longer than the second..... **Hasarius E. S.**
161. Cephalic and thoracic parts on the same plane..... 163
162. Cephalic and thoracic parts on different planes..... **Jelskia Tacz.**
163. Thoracic part but little longer than cephalic 165
164. Thoracic part much longer than cephalic..... **Lyssomanes Hentz.**
165. First pair of legs longest; cephalic part very convex, sides parallel ..... **Athamas Cambridge.**
166. Third pair of legs longest; cephalic part plane, sides converging behind ..... [3]**Epeus Peckham.**

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[1] Thyene=Thya Simon, preoccupied.

[2] Hypoblemum=Drepanephora Keyserling, preoccupied.

[3] Epeus=Evenus Simon, preoccupied.

SUB-FAMILY ATTINÆ.

DIOLENIUS THORELL, 1870.

Syn.: 1870. **Diolenius** THORELL, on Europ. Spid. Part I, p. 203.
1878. " ID., Ragni Malesi e Papuani, Part II, p. 215.
1881. " L. KOCH, Arachniden Australiens, p. 1240.

Thorell (in Europ. Spid., Part I, p. 203,) says that this genus is characterized by the long trochanters of the fore legs.

*TARA N.

Syn.: 1882. **Atrytone** KEYSERLING, Arachniden Australiens, p. 1378.

Cephalothorax low; one quarter longer than wide, in front moderately contracted, behind rounded, wider at the third row of eyes, plane above.

Clypeus very low.

Quadrangle of eyes wider than long, as wide before as behind, placed in front of the middle of the cephalothorax. Dorsal eyes further from each other than from the margin of the cephalothorax. Anterior row of eyes moderately recurved, eyes close together; small medium eyes further from the dorsal eyes than from the lateral anterior eyes.

Falces wide, short, not diverging.

Maxillae dilated in front.

Sternum plane, longer than wide.

Abdomen elongated, above level.

Legs 1, 4, 2, 3, Coxa and trochanter of first pair very much elongated. Patella and tibia of the third shorter than patella and tibia of the fourth; Metatarsus and tarsus of the fourth shorter than the patella and tibia.

LYSTROCTEISA SIMON, 1884.

Lystrocteisa E SIMON. Note sur le Groupe des Diolenii; Comptes Rendus de la Société Entomologique de Belgique. 1884.

Related to Diolenius, but distinct by the following characteristics: ocular quadrangle longer than the thoracic part, much longer than wide, convex in front, flattened in the middle; eyes of the third row very prominent, larger and plainly further apart than the lateral anterior; eyes of the second row much nearer the lateral anterior; trochanter I cylindrical, a little

**Tara* is substituted for *Atrytone*, the latter name being preoccupied.

shorter than the coxa, much shorter than the femur; femur very wide, claviform; tibia almost globular, compressed below with two rows of long spines; metatarsus slender, with two pairs of long spines.

CHALCOLECTA Simon. 1884.

Chalcolecta E Simon. Note sur le Groupe des Diolenii; Comptes Rendus de la Société Entomologique de Belgique. 1884.

Ocular quadrangle at least as long as the thoracic part, of the same form as that of Diolenius; anterior row of eyes less curved than in that genus. Trochanter I shorter than the coxa (particularly ♀) and much shorter than the femur; femur and tibia I very long, compressed, parallel, not dilated, and tibia provided below with two rows of at least 10 + 10 strong spines, alternately shorter and longer; metatarsus shorter than the tibia, ♂ shortened, compressed and angular[1], ♀ cylindrical and provided below with three or four pairs of long spines; relative length of legs 1, 4, 3, 2.

DISCOCNEMIUS Thorell. 1881.

Discocnemius Thorell, Studi sui Ragni Malesi e Papuani, III, p. 428.

Cephalothorax long, moderately high, cephalic part not abruptly higher than thoracic, limited by a transverse depression.

Clypeus very low.

Sternum not narrower than the coxae, not usually projecting between those of the first pair.

Eyes area occupying about half the length of the cephalothorax; quadrangle at least as wide behind as it is long; anterior middle eyes very large; eyes of the second row almost in the middle, between the posterior and the anterior lateral eyes; posterior eyes scarcely or not higher by their own diameter than the anterior lateral eyes.

Maxillae sub-parallel, about twice as long as wide, and about twice as long as the lip. Lip longer than wide, sub-truncated at the extremity.

Legs 4, 1, 2, 3, slender, except the first pair, which is robust (excepting the metatarsus and tarsus); tibia especially wide and compressed, and underneath furnished with a medium longitudinal fascia of dense, long hairs, and two rows of spines, patella and trochanter not usually longer.

Abdomen long.

Spinnerets six, superior and inferior not differing much in length, last joint short.

Type: D. lacertosus.

Related both to Diolenius Thorell and Chirothecia Tacz.

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[1] In the original this sentence reads "metatarse plus court que le tibia, ♂ mutique comprimé et auguleux," etc.

SALTICUS (Latr.) 1804. Simon.

Syn.: 1804. **Salticus** Latr., Nouv. Dict. d'Hist. Nat., XXIV, p. 135, (ad partem).
1805. **Attus** Walck., Tabl. d. Aran., p. 22 (ad partem).
1837. **Pyrophorus** C. Koch, Uebers. d. Arachn.—Syst., 1, p. 29.
1846. **Toxeus** C. Koch, Die Arachn., XIII, p. 19.
1864. **Salticus** [Saltica]: Sub-gen. Pyrophorus [Pyrophora] Sim. H. N. D. Araignees, p. 336.
1869. **Pyroderes** Id., Monogr. d. Attid., p. 248 (714).
1870. **Salticus** Thorell, On Europ. Spid. I, p. 208.
1871. " Sim., Révis. d. Attid.
1876. " Id., Arachn. de France, III, p. 6.
1877. " Thorell, Studi Ragni Malesi e Papuani, I, p. 213.
1878. " Lebert, Die Spinnen der Schweiz, p. 296.
1878. " Tacz., Aranéides du Pérou, Bull. Soc. Imp. des Nat. de Moscou, LIII, 4, p. 371.
1879. " L. Koch, Arachniden Australiens, p. 1055.
1880. " Karsch, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitsch, f. d. gesammt. Naturwissensch., LIII p. 395.
1880. **Toxeus** Id , ibid., pp. 393, 394.

Cephalothorax elongated; cephalic part high, parallel, level, almost as wide as long, its posterior angles rounded; thoracic part narrower, lower, on a different plane, rounded or obtusely truncated behind.

Clypeus very narrow, with sparse hair.

Eyes of the face very unequal, sub-touching, in a straight line, with some hairs around them; dorsal eyes as large as the lateral, a little further apart, forming with them a group wider than long, not, or scarcely projecting.

Sternum very narrow, projecting between the anterior coxæ.

Falces (♂) very long, flat above, horizontal; inferior border of the groove with a continuous row of strong teeth. (♀) Falces short, robust, vertical.

Maxillæ long, square at the extremity, with the superior external angle projecting a little.

Lip much longer than wide, almost parallel, truncated or slightly hollowed.

Palpus (♂) slender; tibia as long and wider than the patella; tarsus oval, rather narrow, and truncated; bulb discoidal, occupying only the inferior part of the tarsus. (♀) Palpus with the tibia and tarsus enlarged in the form of an oval palette.

Legs 4, 1, 3, 2: Third and fourth pairs unarmed; tibiæ and metatarsi of the first and second pairs with two rows of inferior spines; tibia of the first much longer than the patella: patella and tibia of the third much shorter than the patella and tibia of the fourth; tarsus and metatarsus of the fourth a little shorter than the patella and tibia.

LEPTORCHESTES (THORELL) 1870. SIMON.

Syn.: 1832. **Synemosyna** HENTZ, On North Amer. Spid., p. 108 (ad partem).
1837. **Salticus** C. KOCH, Uebers. d. Arachn.—Syst., 1, p. 29 (ad partem.)
1869. " SIM. Monogr d. Attid., p. 6 (16), 241 (707) (ad partem).
1870. **Leptorchestes** THORELL, On Europ. Spid., I, p. 209 (ad partem).
1871. " SIM., Révis. d. Attid. (ad partem).
1876. " ID., Arachn. de France, III. p. 10.
1878. " LEBERT, Die Spinnen der Schweiz, p. 297.
1879. " L. KOCH, Arachniden Australiens, p. 1057.

Cephalothorax plane, but little elevated, parallel, rounded or obtusely truncated behind; a slight transverse depression separating the cephalic part.

Clypeus very narrow.

Eyes of the face very unequal, in a straight line, touching. Dorsal eyes of the same size or barely smaller than the lateral, forming with them a group much longer than wide.

Sternum at least as narrow as the intermediate coxæ, projecting between the anterior coxæ.

Lip almost twice as long as wide, parallel, terminating in an obtuse point.

Falces robust, short, vertical in both sexes.

Palpus (♂) not robust; tibia short with an external apophysis; bulb simple.

Legs 4, 1, 3, 2; third and fourth pairs unarmed: (♂) metatarsi of the first and second with some inferior spines; (♀) tibiæ and metatarsi of the first and second presenting two rows of inferior spines; patella and tibia of the third much shorter than patella and tibia of the fourth; metatarsus and tarsus of the fourth shorter than the patella and tibia.

SYNAGELES SIMON. 1876.

Syn.: 1837. **Salticus** C. KOCH, Uebers. d. Arachn.—Syst., I, p. 29 (ad partem).
1869. " SIM., Monogr. d. espèces Europ. de la fam. d. Attides, p. 241 (707) (ad partem).
1870. **Leptorchestes** THORELL On Europ. Spid. I, p. 209 (ad partem)
1871. " SIM.
1876. **Synageles** ID., Arachn. de France, III, p. 14.
1883. " ID., Arachn. de L'Ocean Atlantique, Ann. Soc. Ent. de France 1862, p. 261.

Cephalothorax flat, but little elevated, very much elongated, parallel, obtusely truncated behind; a slight horizontal depression separating the cephalic part.

Eyes: The dorsal eyes situated a little beyond the middle of the cephalothorax, scarcely projecting above, of the same size as the lateral, and forming with them a group much longer than wide. Eyes of the face very unequal, touching, forming a straight line, surrounded by fine circles of hairs.

Clypeus very narrow; hairs forming the beard sparse.

Sternum oval, more slender at the two extremities, wider in the middle than the intermediate coxae, projecting between the anterior coxae.

Lip at least as wide as long, semi-circular, or in a very obtuse triangle.

Maxillæ extending much beyond the lips but nevertheless rather short and very wide. Square at the extremity.

Legs: Fourth legs the longest; the three anterior pairs equal or almost equal; the two posterior pairs unarmed; (♂) metatarsi of the first and second alone provided with some inferior spines; (♀) tibiae and metatarsi of the first and second presenting two rows of inferior spines; tibia of the first robust, of the same length or scarcely shorter than the patella; patella and tibia of the third much shorter than patella and tibia of the fourth; metatarsus and tarsus of the fourth shorter than patella and tibia.

Falces (♂ ♀) robust, short, vertical.

Palpus (♂) not very robust; tibia very short, provided with an external apophysis; tarsus obtuse oval; bulb simple, reaching at least the superior third of the tarsus; (♀) rather slender; tarsus slightly enlarged and cylindrical.

AGORIUS Thorell. 1877.

Agorius Thorell, Studi sui Ragni Malesi e Papuani, I, p. 216.

Cephalothorax about twice as long as wide, the posterior part plainly narrowing a little, almost vertical towards the sides, rather low, the cephalic part scarcely higher than the thoracic.

Clypeus very low, less than ¼ the diameter of the anterior middle eyes, without thick hairs.

Sternum much wider than the coxæ, not projecting between the coxæ of the first pair.

Eyes: Are a large, occupying almost half the length of the cephalothorax. Quadrangle only a little wider than long, at least as wide in front as behind. Anterior row of eyes rather strongly curved upward, middle eyes plainly visible when the cephalothorax is looked at from above, touching, the lateral well separated from the middle, eyes of the second row small, and a little further from the posterior eyes,

which are but little smaller than the anterior lateral eyes, than from these; posterior eyes further from each other than from the margin of the cephalothorax.

Falces small, vertical (at least in ♀).

Maxillæ diverging a little, sub-ovaté, the extremities appearing rounded, almost twice as long as the lip, which is a little wider than long, narrowing toward the apex.

Legs exceedingly slender, long: 4, 1, 3, 2; trochanters, at least of the fourth pair, much longer than thick; space between the coxæ of the first pair nearly as wide as the sternum; posterior tibiæ and metatarsi without spines. First pair with patellæ very long, almost as long as the femora, and the tibiæ and metatarsi, on the contrary, very short. Two claws, small, slender, bent, strongly curved at the apex, armed with teeth, especially small and short in the tarsi of the first pair; claw tufts distinct.

Abdomen slender, sub-cylindrical; pedicle short, not articulated.

Maxillæ longer, sub-cylindrical.

Pubescence fine and sparse.

Type. A. gracilipes.

This genus is related to Synemosyna Hentz, Salticus Latr., Leptorchestes Thor., and especially to Synagels Sim., differing from this genus in not having the sternum produced between the coxae of the first pair, in the quadrangle of the eyes being shorter, and in the structure of the first pair of legs, which resemble those of Diolenius Thor. However, in Diolenius, it is the trochanters which are elongated, not, as in Agorius, the patellae.

[1] DAMŒTAS N.

Syn.: 1879. Scirtetes L. Koch, Arachn. Australiens, p. 1070.

Cephalothorax almost twice as long as wide, slightly rounded on the sides contracted equally toward the anterior and posterior, convex above. Clypeus low, equaling in height the radius of the lateral eye of the first row.

Quadrangle of eyes longer than wide, wider behind than in front: third series of eyes as wide as cephalothorax. First row of eyes slightly recurved, placed close together. Eyes of the third row more widely separated from each other than they are separated from the margin of the cephalothorax. The middle eyes are much further from the posterior eyes than they are from the lateral eyes of the first row.

Maxillæ convex, margin in front a little rounded. *Lip* scarcely equals half the length of the maxilla, convex, contracted toward the anterior, the tip rounded and swollen.

Sternum long and contracted, convex, projecting between the first pair of thighs.

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[1] *Damœtas* is substituted for *Scirtetes*, the latter name being preoccupied.

Abdomen twice as long as wide; anterior part limited by a transverse impression, covered by a thin skin; posterior part convex, clothed with a hard dorsal integument.

Legs spined, 1, 4, 2, 3; 1 and 4 equal, and 3 and 4 differ slightly in length; first pair stouter than the others. Patella with the tibia of the third pair shorter than the same articulations of the fourth pair; the metatarsus and the tarsus of the fourth pair are shorter than the patella with the tibia.

JANIGENA KARSCH. 1880.

Syn.: 1846. **Janus** C. KOCH, Die Arachn., XIII, p. 21. (ad partem).
1880. **Janigena** KARSCH, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitschr, f. d. gesammt. Naturwissensch., LIII p. 393.

The cephalic part sharply marked off, but not higher than the thoracic part, very flat and wide. The quadrangle of the eyes is wider behind than in front, the palpus over-reaches the very short mandible, also in the male in length in wide contrast to Toxeus and Synemosyna. The two single barren typical specimens do not admit of a more exact definition. Type, Janus melanocephalus (K). As the generic name Janus was preoccupied, (Verany, 1844, Gastropoda) Karsch proposed the name Janigena.

Thorell. in his review of the genera of European spiders, p. 36, had called attention to the fact that the name Janus was preoccupied, even before Verany, 1844. (Janus Steph. [Hymenopt] 1835). See remarks on the genus Synemosyna under that genus.

SYNEMOSYNA HENTZ. 1832.

Syn.: 1832. **Synemosyna** HENTZ, on North Amer. Spid., p. 108.
1846. **Janus** KOCH, Die Arachn., XII I, p. 21 (ad partem).
1870. **Leptorchestes** THORELL, on Europ. Spid., I, p. 209 (ad partem).
1876. " SIM., Arachn. de France, III, p. 10 (ad partem.)
1877. **Synemosyna** THORELL, Studi Ragni Malesi e Papuani, I, p. 198.
1878. **Janus** TACZ., Aranéides du Pérou, Bull. Soc. Imp. des Nat. de Moscou. L. III, 4, p. 372.
1879. **Synemosyna** L. KOCH, Arachniden Australiens, p. 1052.
1880. **Synemosyna** KARSCH, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitschr. f. d. gesammt. Naturwissensch., L. III, p. 395.
1881. " THORELL, Studi Ragni Malesi e Papuani, III, p. 406.

Eyes eight, unequal, in three rows, the first composed of four eyes, the two middle ones largest, the second composed of two small ones placed nearer the first than the third, which is composed of two larger eyes.

Falces short in the females.
Maxillæ slightly inclined toward the lip, truncated at the tip.
Lip short, rounded.
Legs slender, fourth pair longest, the other three variable.
Abdomen contracted near the middle: body nodose, elongated.

Type, S. formica Hentz.

S. formica, upon which species Hentz founded this genus, is undoubtedly identical with Janus gibberosus Koch, which was used to form the genus Janus. Both Hentz and Koch had the spider from Pennsylvania. The other species of Janus described by Koch, J. melanocephalus, has been made the type of the genus Janigena by Karsch.

Hentz, when defining his genus Synemosyna, wrote "cheliceres short in emale," and in contrasting it with Myrmecia notes that in the genus (Myrmecia) "the cheliceres are large in this, (Synemosyna) they are small at least in the female." When describing his typical species — S. formica — he states that "the cheliceres are large *only in the male.*" All the other species placed by him in this genus, both in the male and female have the cheliceres *short.* Now as a matter of fact both sexes in S. formica have short cheliceres. Mr. Emerton first called attention to the error in his notes to Burgess' edition of Hentz's arachnological writings. We have seen a good many males of this spider and all had the short falces. If S. formica represents Hentz's genus, then nearly, if not all, the species placed here by Messrs. L. Koch, Thorell and Karsch, belong in another genus.

RHOMBONOTUS L. KOCH. 1879.

Rhombonotus L. KOCH. Arachniden Australiens, p. 1067.

Cephalothorax almost twice as long as wide, contracted equally in front as behind, slightly convex.

Clypeus about the radius of the middle eyes of the first row.

Quadrangle of eyes longer than wide, narrower in front than behind; the third row of eyes placed behind the middle of the cephalothorax and above the lateral declivity of the same, more widely separated from one another than from the margin of the cephalothorax. The first row of eyes slightly recurved and close together. The middle eyes are nearer the lateral eyes of the first row than the eyes of the third row.

Maxillæ moderately convex, anterior margin round.

Labium half as long as the maxilla, a little contracted toward the anterior, the tip rounded.

Sternum convex, long, contracted, projecting between the anterior thighs

Legs 4, 1, 2, 3.: the second and third pairs of equal length, the first pair more robust than the others. Patella with the tibia of the third shorter than the patella with the tibia of the fourth. The fourth leg has the metatarsus with the tarsus longer than the patella with the tibia.

Abdomen cylindrical, constricted in front of the middle by a transverse impression.

OMOEDUS THORELL. 1881.

Omoedus THORELL, Studi sui Ragni Malesi e Papuani, III, p. 668.

Cephalothorax high behind, anteriorly a little dilated above, the back therefore wide, slanting in front of the posterior eyes, behind them nearly level, strongly rounded behind, when looked at from above, only slightly convex transversely; the posterior slope almost vertical, and transversely concave.

Clypeus rather high.

Eyes quadrangle much wider than long, not occupying half the length of the cephalothorax; almost rectangular; anterior row usually curved; eyes of the second row half-way between the posterior eyes and the anterior lateral eyes; posterior eyes at least their own diameter higher than the anterior lateral eyes, and further from each other than from the lateral borders.

Sternum wider than the coxae, not projecting between the widely separated coxae of the first pair.

Falces short, sub-vertical.

Maxillae long, narrow at the base, sub-ovate. Lip scarcely or not wider than long, apex somewhat rounded.

Palpi those of the female not dilated nor flattened toward the apex.

Legs rather short, (♀) 4, 3, 1, 2 (or 2, 1?); tibia with patella of the fourth pair longer than tibia with patella of the third.

Abdomen short, a little flattened, the anterior margin truncated, covered with delicate skin.

Spinnerets six, the superior much more slender than the inferior.

Type O. niger.

This genus resembles Coccorchestes Thor., differing from it especially in having the body sub-flattened, not strongly convex. It differs from ordinary Attidae much less than Coccorchestes.

COCCORCHESTES THORELL. 1881.

Coccorchestes THORELL, Studi sui Ragni Malesi e Papuani, III., p. 671.

Cephalothorax slanting in front of the posterior eyes, very high behind them and nearly level or ascending, the posterior margin of the back widely truncated.

Clypeus high, inclined backward.

Eyes quadrangle wider than long, scarcely or not occupying half the greatest length of the cephalothorax; anterior row with the eyes sub-touching, only slightly curved upward, eyes of the second row further from the posterior eyes than from the anterior lateral eyes; posterior eyes more than their own diameter higher than anterior lateral eyes.

Sternum wider than the coxae, not projecting between the separated coxae of the first pair.

Falces short, sub-vertical.

Maxillae short, narrow at the base, wide at the apex, almost ovate triangular. Lip a little longer than wide, rounded at apex.

Palpi of the female a little dilated and usually convex toward the apex.

Legs moderately short, 4, 1, 2, 3 (3, 2), femora robust and compressed.

Abdomen short, almost ovate triangular, high and widely truncated in front, anterior slope convex, and received into the excavation of the cephalothorax, covered with hard shining scales forming a shield.

Spinnerets six, the superior longer and more slender than the inferior.

The whole spider is very convex, both longitudinally and transversely when looked at from above strongly resembling a beetle.

HOMALATTUS White. 1841.

Syn.: 1841. **Homalattus** White, Description of new or little known Arachn., *in* Ann. and Mag. of Nat. Hist., VII, p. 476.
1848. **Rhanis** C. Koch, Die Arachn., XIV, p. 86.
1870. **Rhene** Thorell, on Europ. Spid. I, p. 37.
1877. **Homalattus** Id., Studi sui Ragni Mal. e Pap., I, p. 289.
1878. **Rhene** Tacz., Aranéides du Pérou, Bull. de la Soc. Imp. de Moscow, LIII, 4, p. 289.
1879. **Homalattus** L. Koch, Arachniden Australiens, p. 1083.
1880. " Karsch, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitsch. f. d. gesammt. Naturwissensch., LIII, p. 396.

Cephalothorax flat, transverse, not so wide as the body, covered like it with papillae.

Eyes eight, on short elevations of thorax; may be considered as placed in three lines, two of which are approximate, the third being distant; the first line, which is somewhat bent, contains four eyes, placed on the front margin of the cephalothorax at nearly equal distances from each other, the two intermediate eyes are much the largest. The second line contains two very minute eyes, somewhat removed from the edge of the thorax; they are placed rather nearer the outer eye of the first line than the outer is to the intermediate; the third line contains two eyes, one on each side of the margin of the thorax, the space between the outer eye and the first line being equal to the distance between the outer eyes of the first line.

Abdomen as broad as long; in front straightish; behind somewhat pointed; the sides rounded; it is flat and compressed, and somewhat convex above.

NEON Simon. 1876.

Syn.: 1869. Attus Sim., Monogr. d. espèces Europ. de la fam. d. Attides, p. 14 (24) (ad partem).
1871. " Id., Revis d. Attid.
1872. Euophrys Thorell, on European Spiders, II, p. 404.
1876. Neon Sim., Arachn. de France, III, p. 208.
1880. " Karsch, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitsch. f. d. Naturwissensch., LIII, p. 397.

Cephalothorax not high; cephalic part a little longer than the thoracic: the latter very slightly contracted and widely truncated.

Eyes of the face touching, forming a straight line. Dorsal eyes at least as large (often larger) than the lateral, very convex, not prominent; as far apart as the lateral eyes, since the sides of the quadrangle are parallel.

Clypeus less than half as wide as the middle eyes, almost glabrous.

Sternum triangular, much wider than the intermediate thighs.

Legs short; those of the fourth pair the longest; those of the first and third pairs nearly equal; those of the second pair the shortest; first pair a little thicker than the others; third and fourth pairs without spines; first and second pairs presenting below two rows of tibial and metatarsal spines usually long and bristle-like. Tibia and patella of the third shorter than tibia and patella of the fourth; tarsus and metatarsus of the fourth very slightly shorter than the patella and tibia.

Falces obliquely inclined, short, slender, taken together narrower than the two middle eyes.

Integument ornamented.

Spinnerets the superior ones longer than the inferior, and more slender; very far apart, leaving visible the inferior ones to the base, formed of two articulations, the second very short.

*IONA N.

Syn.: 1882. Erasmia Keyserling, Arachniden Australiens, p. 1350.

Cephalothorax one third longer than wide, a little contracted toward the front, behind rounded, not wider at the dorsal eyes, above plain.

Clypeus half the diameter of the large eyes.

Quadrangle of eyes wider than long; wider in front than behind; dorsal eyes placed a little behind the middle of the cephalothorax, almost further from each other than from the margin of the cephalothorax. First row of eyes slightly recurved and very close together. Small median eyes half way between the anterior lateral and the dorsal eyes.

**Iona* is substitued for *Erasmia*, the latter name being preoccupied.

Falces short, not diverging.

Labium half as long as the maxilla; slightly contracted anteriorly.

Sternum oval; one third longer than wide.

Legs 1, 4, 3, 2. Third and fourth equally long. First pair as stout or a little stouter than than the others. Patella and tibia of the third longer than the patella and tibia of the fourth. Metatarsus and tarsus of the fourth longer than the patella and the tibia. Metatarsus of the fourth without spines.

Abdomen long, ovate.

MAGO Cambbidge. 1882.

Mago O. P. Cambridge. Proc. Zool, Soc., London, May 16, 1882, p. 432.

Cephalothorax as high behind as it is long; the posterior slope curved inwards, but almost perpendicular; profile of upper side of caput slightly convex, and sloping a little forward. The caput is exceedingly large, absorbing, in fact, almost the whole cephalothorax. Looked at from above, its upper surface forms nearly a square; the sides are perpendicular.

Height of clypeus less than the diameter of the fore central eyes.

Ocular area slightly broader than long, and equal in breadth before and behind; fore central pair of eyes very large, and of a dull, pearl-grey hue; fore laterals in a line with base of fore centrals, and of same color; posterior pair a little smaller than fore laterals, and as nearly as possible equally divided from them by the minute, intermediate eye, which is placed a little inside of their straight line.

Legs moderately long, tolerably strong, 1, 3, 2, 4; first pair much the strongest. Armed with spines. and with a small claw-tuft beneath the terminal tarsal claws.

Falces long, straight, divergent, and directed forward; denticulations small; fang of moderate length and strength.

Maxillae long, strong, straight; widened on both sides at the extremities, which are rounded.

Labium long, about two thirds the length of the maxillae, and narrower at the apex than base; apex rounded. The direction of the maxillae and labium is very nearly perpendicular (or at right angles) to the *sternum*, which is small, nearly round, slightly pointed behind and truncated in front; the truncation is very gently curved, the convexity of the curve directed backwards.

Abdomen small, short, oval, very convex before, and fitting up pretty closely to the incurved thorax.

ERIS (C. Koch). 1846. Simon.

Syn.: 1846. Eris C. Koch, Die Arachn., XIII, p. 189.
1850. " Id., Uebers. d. Arachn.-Syst., 5, p. 59.
1869. Attus Sim., Monogr. d. Attid., p. 6 (16) 14 (24) (ad partem).
1871. " Id., Révis, d. Attid. (ad partem).
1876. Eris Id., Arachn. de France, III, p. 197.
1880. " Karsch, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitsch. f. d. gesammt. Naturwissensch., LIII, p. 397.
1883. " Sim., Arachn. de l'Ocean Atlantique. Ann. Soc. Ent. de France, 1882, p. 303.

Cephalothorax moderately high, wide, and short; cephalic and thoracic parts of the same length; the latter very much inclined, contracted, truncated or slightly hollowed.

Clypeus moderately high, with hairs.

Eyes of the face very unequal, in a curved line; the lateral widely separated. Dorsal eyes scarcely smaller than the lateral, situated at the widest point of the cephalothorax, and not prominent.

Sternum short, as narrow or narrower than the intermediate coxae. Interval between the anterior coxae often less wide than the lip at the base.

Falces vertical, short, thick.

Legs 1, 4, 3, 2, or 4, 1, 3, 2: first pair more robust than the others, often, in the males, its femur and tibia dilated. Tibia and patella of the third plainly shorter than tibia and patella of the fourth. Tarsus and metatarsus of the fourth of the same length as or scarcely shorter than patella and tibia. Tibial and metatarsal spines on the four pairs; less numerous, and only appearing at the extremities of the articulations on the posterior pairs.

*BIANOR N.

Syn: 1883. Scythropa Keyserling, Arachniden Australiens, p. 1446.

Cephalothorax a little longer than wide, sides rounded, before and behind equally contracted, high and convex, not wider than the dorsal row of eyes.

Clypeus low.

Quadrangle of eyes behind wider than long, in front contracted, reaching the middle of the cephalothorax. Anterior row substraight; the lateral a little separated from the middle eyes. Dorsal eyes further from one another than from the margin of the cephalothorax. The small median eyes are nearer the anterior lateral than the dorsal eyes.

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* *Bianor* is substituted for *Scythropa*, the latter name being preoccupied.

Falces vertical, not diverging.
Maxillæ twice as long as the labium, dilated and rounded in front.
Labium not longer than wide.
Sternum twice as long as wide.
Legs 1, 4, 3, 2. First pair stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth; metatarsus and tarsus of the fourth a little shorter than the patella and tibia. Metatarsi of the fourth spined only at the apex.
Abdomen oviform; one fourth longer than wide.
Spinnerets as usual; superior and inferior equally long.

PIRITHOUS Keyserling. 1883.

Syn.: 1882. **Eulabes** Keyserling, Arachniden Australiens, p. 1387.
1883. **Pirithous** Keyserling, Arachniden Australiens, p. 1477.
Cephalothorax a little longer than wide, sides rounded, behind slanting and contracted, above moderately high and plane, wider at the dorsal row of eyes.
Clypeus low.
Quadrangle of eyes wider than long, behind wider than in front, almost reaching the middle of the cephalothorax. First row of eyes strongly recurved, lateral eyes from the large middle eyes widely separated. small medium eyes further from the dorsal eyes than from the anterior lateral. Dorsal eyes further from one another than from the margin of the cephalothorax.
Falces diverging.
Maxillæ long, a little dilated in front.
Labium longer than wide, not longer than half the length of the maxilla.
Sternum small and a little longer than wide.
Abdomen oval.
Legs spined, 1, 2, 4, 3, or 1, 4, 2, 3; first pair stouter than the others; patella and tibia of the third shorter than the patella and tibia of the fourth. Metatarsus and tarsus of the fourth shorter than the patella and the tibia. Metatarsi of the fourth spined.
The generic name Eulabes was preoccupied.

[1] NEAETHA Simon. 1885.

Syn: 1869. Attus Sim., Monogr. d. espêces Europ. de la fam. d. Attides, p. 14 (24) (ad partem).
1871. " id., Revis. d. Attid.
1876. Neera id., Arachn. de France, III, p. 199.
1885. Neaetha id., Etude sur Arachn. recueillis en Tunisie, Paris, Imp. Nat. 1885.

[1] Neatha = Neera, preoocupied.

Cephalothorax high; cephalic and thoracic parts of the same length; the latter very much inclined, contracted, truncated, or slightly hollowed.

Eyes: those of the face but little separated, forming a straight line. Dorsal eyes a little smaller than the lateral, not prominent, situated at the widest point of the cephalothorax, further apart than the lateral since the sides of the quadrangle diverge behind.

Clypeus almost half as wide as the middle eyes, with thick hairs.

Sternum oval, of the same width as the intermediate thighs.

Legs 3, 1, 4, 2, or 1, 3, 4, 2; first pair much more robust, with the femur compressed, dilated above, and claviform; patella and tibia of the first thick and cylindrical. Tibia and patella of the third much longer than tibia and patella of the fourth; metatarsus and tarsus of the fourth as long or scarcely shorter than the tibia and patella. Tibial and metatarsal spines on the four pairs; the metatarsus of the fourth having only a circle of terminal spines.

Falces vertical, not long.

CIRIS C. Koch. 1848.

Syn.: 1848. **Ciris** C. Koch, Die Arachn., 14, p. 85.
1850. " Id., Uebers. d. Arachn. Syst., 5, p. 69.
1877. " Thorell, Studi Ragni Malesi e Papuani, I., p. 283

Cephalothorax short, flat above, scarcely longer than it is wide.

Eyes of the face in a straight row.

Falces strong, thick, not long, wrinkled, shining, vertical.

Palpus of the female of not unusual form, the tarsus tapering oval.

Legs short, nearly equally long,

Abdomen very short, almost circular.

Spinnerets drawn in and scarcely visible.

Thorell remarks that Ciris is near to Ballus (C. Koch) and more especially to Neera Simon, in that the eye area is large, occupying one half the cephalothorax; while it differs from Neera in having the quadrangle of the eyes not wider, but a little narrower behind than in front, and the third pair of legs only a little longer than the fourth. Studi Ragni Malesi e Papuani, I, p. 285.

BALLUS (C. Koch). 1850. Simon.

Syn.: 1837. **Euophrys** C. Koch, Uebers. d. Arachn. Syst., I, p. 33 (*ad partem.*
1846. **Marpissa** Id., Die Arachn. XIII, p. 53 (*ad partem*).
1850. **Attus:** sub.-gen. Ballus Id., Uebers. d. Arachn. Syst., 5 p. 68.
1869. " Sim., Monogr. d. Attid., p. 3 (16) 14 (24) (*ad partem*).
1870. **Ballus** Thorell, On Europ. Spid., I, p. 212.

1871. **Attus** Sim., Révis d. Attid.
1876. **Ballus** Id., Arachn. de France, III, p. 201.
1876. **Oedipus** Menge, Preussische Spinnen, IX, p. 482.
1877. **Ballus** Thorell, Ragni Malesi e Papuani, p. I, 286.
1878. " Lebert, Die Spinnen der Schweiz, p. 301.
1881. " Thorell, Ragni Malesi e Papuani, III. 665.
1882. " L. Koch and Keyserling, Arachn. Australiens, p. 1335.

Cephalothorax flattened: cephalic and thoracic parts of the same length; the latter contracted, inclined, truncated or slightly hollowed behind.

Clypeus less than half as wide as the large middle eyes.

Eyes of the face sub-touching, forming a straight or barely curved line. Dorsal eyes of the same size as the lateral, not prominent, situated at the widest point of the cephalothorax, much further apart than the lateral.

Sternum attenuated at both extremities, a little wider than the intermediate coxae.

Falces short, plane, or a little flattened in front.

Palpus (♂) not very long, and not robust; tibia shorter than patella, with an external terminal apophysis, slender, tarsus oval, relatively narrow.

Legs short; the fourth pair longest, the first pair much the most robust, with femur and tibia much dilated, often flattened and claviform. Tibia and patella of the third much shorter than tibia and patella of the fourth; metatarsus and tarsus of the fourth usually shorter than tibia and patella. Legs of the two posterior pairs entirely without spines (except ænesiens); legs of the two first pairs having below two rows of tibial and metatarsal spines.

Integument covered with moderately long pubescence, simple, rarely scaly.

CHIROTHECIA Taczanowski. 1878.

Chirothecia Taczanowski, Bulletin de la Société Impériale des Naturalistes de Moscou, Tome LIII, 1878, No. 4, p. 362.

Cephalothorax low, flattened on the back; head much longer than wide, perfectly plane above; thoracic part shorter than the cephalic, a little lower behind.

Eyes of the third row placed very far back; those of the second row nearer the anterior than to the posterior eyes, and nearer each other than are the anterior and posterior lateral eyes. The tops of the anterior eyes are in a perfectly straight line; the middle eyes are very large, occupying the entire width of the face; the external eyes of this row are considerably larger than the eyes of the other rows.

Falces large, short and almost vertical in the female; long, horizontal, and armed with a long recurved hook in the male.

Legs ordinary and slender excepting those of the first pair which are thicker than the others, with the tibia enlarged and hollowed on its internal border to form a moderately deep groove; each of the borders of this groove has three long spines each articulated on an elevation which is low but much larger than the spine, and some irregularly distributed bristles; at the bottom of the groove is found a comb composed of wide, flattened hairs, which are crowded closely together, and disposed in a simple row.

Figure small.

This curious genus, in which the first legs are much thicker than the others, with the tibia greatly enlarged, resembling at the first glance the claws of crayfish and yet more those of chelifers, is characterized also by the extreme flatness of the cephalothorax, by the length of the cephalic part, and by the eyes of the last row being placed very far back.

COCALUS C. KOCH. 1846.

Syn.: 1846. **Cocalus** C. KOCH, Die Arachn., 13, p. 180.
1850. " ID., Uebers. d. Arachn. Syst., 5, p. 48.
1877. " THORELL, Studi Ragni Malesi e Papuani, I, p. 254.
1878. " ID., ibid., II, p. 283.
1881. " ID., ibid., III, p. 492.

Eyes of the first row all close together in a straight line. The two middle eyes are large, the outer, in diameter, scarcely half as large as the middle eyes; the eyes of the third row looking sideways, standing in a quadrangle with the first row, and as large as the lateral eyes of that row; the eyes of the second row only a little smaller than these, and placed half way between them.

Falces long, slender, vertical, cylindrical, with a rather short fang.

Palpus rather long, the first three joints slender, the fourth wide and short, the tarsus large, swollen, the bulb entirely covered; the bulb simple, with protuberances (einfach knotig), projecting a little forward.

The cephalothorax of this spider departs from all known species. The headplate forms an ascending slope from the first row of eyes, and ends in a roof-shaped ridge from which the thorax falls in a steep slope, to the hinder edge; the sides of the cephalothorax, however, are almost vertical, and therefore when looked at from above, it appears narrow. The abdomen is much narrower than the cephalothorax and cylindrical. The spinnerets are, in comparison with other genera, long and slender, the two upper and the two lower however, have but half the length of the two middle ones. The legs are rather long, the first and fourth pairs almost equally long, the second pair somewhat shorter than the first, and the third somewhat shorter than the second. All are rather slender.

[1] LINUS N.

Syn.: 1878. **Sinis** Thorell, Studi sui Ragni Malesi e Papuani, II p. 269.

Cephalothorax not much longer than wide, and very high, sloping steeply in front.

Clypeus at least half as high as the middle anterior eyes.

Sternum sub-ovate, wider than the coxae.

Eyes: quadrangle rather large, occupying about ⅔ of the length of the cephalothorax, not much wider than long, a little narrower behind than in front, and but little narrower behind than the cephalothorax at that place. The anterior row of eyes, which is plainly visible when looked at from above, is a little curved upward. Middle anterior eyes very large, at least three times larger than the lateral eyes, and separated from them by only a small interval; eyes of the second row rather large, more than a third as large as the posterior eyes, and placed half-way between these, and the anterior lateral eyes; the posterior eyes, which are placed more than their own diameter higher than the anterior lateral eyes, are further from the lateral borders than from each other.

Falces short, not.

Maxillae sub-ovate, diverging, narrow at the base, almost twice as long as the lip; lip a little longer than wide.

Legs long, 1, 4 (in ♀ 4, 1), 2, 3, metatarsi and tarsi very narrow; first pair only a little more robust than the others, tibiae much longer than patallae; tibiae also spined above; posterior metatarsi with spines throughout their length.

Abdomen sub-ovate.

Spinnerets ordinary, two articulations, the superior the longer.

Type: S. fimbriatus (Dol.).

This genus is nearly related to Cocalus (C. L. Koch).

HYCTIA Simon. 1876.

Syn.: 1869. **Marpissus** Sim., Monogr. d. espèces Europ. de la fam. d. Attides, p. 7 (17) (ad part.).

1871. " Id., Revis. d. Attid.

1876. **Hyctia** Id., Arachn. de France, III, p. 18.

Cephalothorax elongated, almost parallel: thoracic part scarcely at all enlarged, at least a third longer than the cephalic part. Cephalic part flat, not inclined, limited by a wide depression, not deep, bent behind.

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[1] *Linus* is substituted for *Sinis*, the latter name being preoccupied.

Eyes of the face very unequal, touching, at least the middle eyes, forming a straight line; dorsal eyes almost as large as the lateral, not further apart, the sides of the head thus being parallel; the square almost as long as wide; the dorsal eyes much further from each other than from the lateral borders.

Clypeus scarcely a third as wide as the middle eyes.

Sternum small, narrow, twice as long as wide, thighs longer than wide, those of the first pair much thicker and longer than the others, tou hing.

Legs 1, 4, 2, 3; first pair very long and robust; femur dilated and compressed; patella and tibia cylindrical, the latter always a third the longer; these two articulations longer (♂) or almost as long (♀) as the cephalothorax; tarsus and metatarsus slender, shorter than the patella and tibia; tarsus a third shorter than the metatarsus. [1] Second, third, and fourth legs short and slender. Tarsus and metatarsus of the fourth shorter, or almost as long as the patella and tibia. On the anterior pairs two inferior rows of tibiae and metatarsal spines; on the posterior pairs two inferior tibial spines, and one or two metatarsal spines.

Falces robust, longer than the face, (♀) vertical, (♂) lightly inclined forward.

Palpus (♂) slender; femur narrow and a little curved; tarsus oval, not large; bulb simply rounded above, prolonged into a point behind.

Abdomen narrow, elongated.

MITHION Simon. 1884.

Mithion E. Simon, Arachnides recueillis a Khartoum; Bulletin de la Société Zoologique de France, T. IX.

Cephalothorax much elongated, almost parallel; thoracic part at least a third the longer; cephalic part almost plane, little elevated, not inclined, with posterior depression lacking, or very slight.

Eyes of the face touching, with their tops in a straight line, extremely unequal, the median at least five times the larger, very convex and prominent. Dorsal eyes as large as the lateral, not, or scarcely further apart. Quadrangle as long as wide, parallel. Dorsal eyes much further from one another than from the lateral borders.

Clypeus having scarcely a quarter the diameter of the midde eyes.

Falces (♀) very short, almost square and vertical.

Sternum oblong oval, narrowing in front and behind, of the same width in the middle as the intermediate thighs. Thighs I separated by the width of the labium at the base, much thicker than the others; thighs II thicker than III; III and IV almost equal.

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[1] Simon's description reads "first, third and fourth;" doubtless an error.

Patella and tibia I shorter than the cephalothorax, tibia scarcely longer than patella and as thick; tibia and patella IV a little longer than tibia and patella III; tarsus and metatarsus IV almost as long as patella and tibia; tibia IV at least a third longer than patella, cylindrical, neither attenuated or enlarged at the extremity. Spines short and serial on the tibiae and metatarsi I and II; slender on pairs III and IV; metatarsi III and IV with a whorl of terminal spines; and with two or three small spines toward the middle; spinnerets very long, particularly the superior ones, cylindrical.

This new genus resembles Marpissa, and still more Hyctia, differing from them in having the anterior thighs separated at the base by the width of the labium. It is closely related to the genus Icius E. S, but is distinguished from it by the quadrangle of the eyes being as long as wide and parallel, while in Icius it is plainly wider than long, and a little wider behind than in front, by the anterior median eyes being yet more large and prominent, and finally by the presence of several spines (one underneath and two internal lateral) on the posterior metatarsi, besides the terminal circle. It presents also a certain resemblance to the genus Thya, having the same kind of coloring, the scaly hairs, and the tufts of hairs in the form of horns on the cephalothorax, but it is far removed from it by the form of the cephalothorax and the proportions of the articulations of the two pairs of posterior legs.

MARPTUSA (THORELL), 1877. SIMON.

Syn.: 1837. **Dendryphantes** C. KOCH, Uebers. d. Arachn.-Syst., 1, p. 31 (ad partem).

1846. **Marpissa** ID., Die Arachn., XIII, p. 56 (ad partem).

1869. **Marpissus** SIM., Monogr. d. Attid., p. 6 (16), 7 (17) (ad partem).

1870. **Marpessa** THORELL, on Europ. Spid., I, p. 213 (ad partem).

1876. **Marpissa** SIM, Arachn. de France, III, p. 23.

1877. **Marptusa** THORELL, Ragni Malesi e Papuani, I, p. 221 (ad partem).

1878. " ID., ibid., II, p. 24 (ad partem).

1878. **Marpessa** LEBERT, Die Spinnen der Schweiz, p. 201 (ad partem).

1878. **Marpissa** TACZ., Aranéides du Pérou, Bull. Soc. Imp. d. Nat. de Moscou, LIII, 4, p. 217.

1879. **Marptusa** L. KOCH, Arachnidea Australiens, p. 1092 (ad partem).

1881. " THORELL, Studi Ragni Malesi e Papuani, III, p. 432 (ad partem).

Cephalothorax long; thoracic part a little dilated, at least a third the longer; cephalic part entirely plane, limited behind by a transverse depression.

Clypeus about half as wide as the middle eyes.

Eyes of the face rather unequal, forming a straight or scarcely curved line, a little separated: interval of the lateral wider than that of the middle, and yet not more than half their diameter. Dorsal eyes as large or almost as large as the lateral, a little further apart, since the sides of the head diverge a little behind; quadrangle at least a quarter wider than long; dorsal eyes much further from each other than from the lateral borders.

Sternum narrow, twice as long as wide. Anterior coxae almost touching, their interval much less wide than the lip; all the coxae longer than wide, those of the first pair thicker and a little longer than the others.

Palpus (♂) with the tarsus much enlarged in the form of a palette, and projecting beyond the bulb on all sides.

Legs of the first and second pairs equal or almost equal; those of the third and fourth a little shorter, equal or almost equal. First pair very robust: femur dilated and compressed; patella and tibia cylindrical, equal, or tibia barely longer (M. radiata ♂); these two articulations always shorter than the cephalothorax; tarsus and metatarsus more slender and shorter than patella and tibia; tarsus a little shorter than the metatarsus. Tarsus and metatarsus of the fourth shorter than the patella and tibia. Continuous inferior rows of tibial and metatarsal spines; tibial spines less numerous and less regular on the posterior pairs; usually the metatarsi of the fourth with only a terminal circle of spines.

In the Arachniden Australiens (p. 1093) Koch has used this genus in a different sense from both Simon and Thorell. The two latter define the clypeus as *about* half the middle eyes of the first row. Dr. Koch on the contrary extends the definition to include species where the middle eyes are equal to the clypeus or even overhanging the falces. Judging from the excellent figures which Koch gives, the spiders included in this genus form a very heterogenous group.

MENEMERUS Simon, 1869.

Syn.: 1848. **Euophrys** C. Koch, Die Arachn., XIII, p. 200 (ad partem).
1869. **Menemerus** Sim., Monogr. d. Attid., p. 6 (16), 196 (662).
1870. " Thorell, On Europ. Spid., I, p.214 (ad partem).
1870. **Marpessa** Id., ibid., p. 213 (ad partem).
1876. **Menemerus** Sim., Arachn. de France, III, p. 30.
1877. " Thorell, Studi Ragni Malesi e Papuani, I, p .228 (ad partem).
1878. " Id., ibid., II., p. 237 (ad partem).
1879. " L. Koch, Arachniden Australiens, p. 1123.

1881. **Menemerus** THORELL, Studi Ragni Malesi e Papuani, III, p. 500 (ad partem).

1883. " L. KOCH and KEYSERLING, Arachniden Australiens, p. 1461.

1883. " SIM, Arachn., de l'Ocean Atlantique. Ann. Soc. Ent. de France, 1882, pp. 261, 284, 303.

Cephalothorax elongated; thoracic part a little dilated, at least a third the longer; cephalic part flat, or very slightly convex, limited by a wide and shallow transverse depression.

Clypeus scarcely half the anterior middle eyes.

Eyes of the face rather unequal, forming a line slightly curved (rarely straight), a little separated, particularly the lateral eyes. Dorsal eyes a little smaller (sometimes as large; M. falsificus) than the lateral, not further apart, since the sides of the head are straight; quadrangle a quarter or a fifth only (M. semilimbatus) wider than long; dorsal eyes as far from one another as from the lateral borders (M. semilimbatus) or further from one another.

Sternum almost twice as long as wide; attenuated in front. Anterior thighs separated by the width of the lip at the base; all the thighs longer than wide; those of the first pair the longest.

Legs (♂) 1, 4, 2, 3, or 4, 1, 2, 3; (♀) 4, 1, 2, 3. Legs of the first pair thickest; femur compressed; patella and tibia cylindrical, the latter longer (except M. falsificus); tarsus and metatarsus more slender and much shorter than the patella and tibia; tarsus shorter than the metatarsus. Tarsus and metatarsus of the fourth shorter than patella and tibia; patella and tibia of the fourth much longer than patella and tibia of the third: tibia of the fourth cylindrical and parallel. Tibial and metatarsal rows of inferior spines on the four pairs.

Palpus short; femur very much dilated, almost as wide as long; convex above; patella and tibia short and almost equal; tarsus rather small, very convex.

Abdomen oval, a little flattened.

This seems to differ from Attus only in the slightly lesser width in proportion to the length of the quadrangle of the eyes.

DENDRYPHANTES (C. KOCH), 1837. SIMON.

Syn.: 1837. **Dendryphantes** C. KOCH, Uebers. d. Arachn.-Syst., I, p. 31 (ad partem).

1850. " ID., ibid., 5 p. 60 (saltem ad partem).

1869. **Attus** SIM., Monogr. d. Attid., p. 6 (16), 14 (24) (ad partem).

1870. **Dendryphantes** THORELL On Europ. Spid., I, p. 214.

1870. **Marpessa** ID., ibid., p. 213 (ad partem).

1871. **Attus** SIM., Révis. d. Attid. (ad partem).

1876. **Dendryphantes** Sim., Arachn. de France, III, p. 35.
1878. " Lebert, Die Spinnen der Schweiz, p. 303 (ad partem).
1878. " Tacz., Aranéides du Pérou *in* Bull. Soc. Imp. d. Nat. de Moscou LIII, 4, p. 309.
1880. " Karsch, Arachnol Blättter VIII, Zur Keuntniss der Attiden, *in* Zeitsch. f. d. gessamt. Naturwissensch., LIII, p. 397.
1883. " Sim., Arachnides de l' Ocean Atlantique, Ann. Soc. Ent. de France, 1882, p. 260

Cephalothorax moderately high; thoracic part plainly dilated, at least a third the larger; cephalic part level, often a little limited by a transverse depression.

Clypeus less than half as wide as the large middle eyes.

Eyes of the face rather unequal, in a line considerably curved; the middle eyes not touching; the lateral separated by an interval often equal to half their diameter. The dorsal eyes almost as large as the lateral, a little further apart, since the sides of the head diverge behind. Quadrangle a third wider than long. Dorsal eyes further from one another than from the lateral borders.

Sternum elongated, rather narrow. Anterior coxae separated by the width of the lip, and much thicker than the others; coxae of the fourth pair a little longer than the intermediate pairs.

Falces robust and vertical in both sexes.

Palpus (♂) rather slender; patella longer than tibia; tarsus narrow, oval, truncated at the extremity.

Legs (♂) 1, 2, 4, 3, or 4, 1, 2, 3; (♀) 4, 1, 2, 3, or rarely 4, 1, 3, 2; the first and (sometimes) second pairs more robust with compressed femora. Tibia and patella of the first shorter than the cephalothorax; (♂) tibia longer; (♀) tibia and patella equal. Tibia and patella of the third much shorter than tibia and patella of fourth. Tarsus and metatarsus of the fourth plainly shorter than tibia and patella. Tibia of the fourth cylindrical and parallel; metatarsus of the fourth with only a circle of spines at the extremity.

PSECAS C. Koch, 1850.

Psecas C. Koch, Uebers. d Arachn. Syst., 5, p. 49.

Eyes like the genus Marpissa.

Falces rather long, cylindrical, vertical.

Palpus in the male rather short, the tarsus glossy, the bulb pointed at the extremity.

Head and thorax nearest in form to the genus Marpissa. The face in front is as low, and is scarcely higher than the middle eyes of the first

row. The falces are somewhat longer and in the only example that I have seen somewhat hidden under the palpus, so that the form is only imperfectly to be seen. The legs differ essentially from all the genera of the Salticidae, in that the tarsal joint is very short in proportion to the metatarsal. The legs are somewhat robust, the first and fourth pairs the longest and about equal in length, the second and third pairs growing somewhat shorter by degrees. The middle spinnerets are long, decidedly longer than usual, the others only half as long; in this the genus unites with Cocalus, to which altogether, it bears some likeness.

BŒTHUS THORELL, 1878.

Syn.: 1878. **Bœthus** THORELL, Studi sui Ragni Malesi e Papuani, II, p. 220.
1881. " ID., ibid., III., p. 431.

Cephalothorax short, high, sloping steeply in front, the cephalic part not narrower anteriorly.

Clypeus about ¼ as high as the middle eyes.

Sternum much wider than the coxae.

Eyes: quadrangle large, occupying more than $\frac{2}{3}$ (not indeed half) of the length of the cephalothorax, a little wider than long, wider in front than behind, where it is only a little narrower than the cephalothorax at that place. The anterior row of eyes, which is plainly visible when the cephalothorax is looked at from above, is only slightly curved upward; the middle anterior eyes are large, very prominent and sub-touching. the lateral much smaller, and a little larger than the posterior eyes, which are placed more than their own diameter higher than the lateral eyes, and are a little further from the lateral borders than from each other. Eyes of the second row rather large, placed almost in the middle between the posterior and the lateral eyes, and as high as the latter.

Falces as usual, sub-vertical.

Maxillae long and narrow, more than twice as long as the lip. Lip almost equally long and wide, widely truncated at extremity.

Legs moderately long, rather slender, 4, 1, 2, 3. First pair a little more robust than the others, tibiae and metatarsi with a few spines underneath, which are long and adpressed; tibia but little longer than metatarsus. Tibia with patella of fourth, longer than tibia with patella of third. Posterior metatarsi with spines throughout their length. The two tarsal claws moderate, not curved, slightly convex on the back, pectinated with many short teeth. Scopula dilated a little at the apex.

Abdomen long, a little flattened.

Spinnerets the superior, rather long, with two joints, which are conical, and at least as long as wide, the inferior ones sub-conical thicker and shorter than the superior.

Type: B. spinimanus.

In the general form of the body this genus stands about half-way between Attus (Walck) Thorell and Euophrys (C. Koch) Thorell, being distinguished from the former by its low clypeus, and from the latter by the posterior eyes being a little further from the margin of the cephalothorax than from each other; and agreeing in the form of the abdomen more with Marptusa Thorell; the form and armature of the first pair of legs, however, separates it widely from these genera; in this respect it is more like Synemosyna and Diolenius.

PLEXIPPUS (C. KOCH), 1843. KEYSERLING.

Syn.: 1846. **Plexippus** C. KOCH, Die Arachn., XIII, p. 93.
1877. " THORELL, S udi Ragni Malesi e Papuani, I, p. 262.
1878. " ID., ibid., II, p. 240.
1880. " KARSCH, Arachnol. Blätter, VIII, Zur Kenntniss der Attiden, *in* Zeitsch. f. d. Naturwissensch. LIII, p. 398.
1881. " THORELL, Studi Ragni Malesi e Papuani, III, p. 526.
1883. " L. KOCH and KEYSERLING, Arachniden Australiens, p. 1425.

Cephalothorax moderately high, descending steeply to the posterior border, slightly convex over the back, a fourth or a fifth longer than wide, gently rounded on the sides, and only a little wider at the third row of eyes.

Eyes of the face in a moderately bent row, the lateral half as large as the middle eyes and only slightly separated from them. The eyes of the third row smaller than the lateral eyes of the first row. The small median eyes nearer the anterior than the posterior lateral eyes. [1]The quadrangle longer than wide, and a little wider behind than in front, not reaching the middle of the cephalothorax. The eyes of the third row further from each other than from the lateral borders.

Sternum somewhat wider than the coxae of the second pair.

Falces rather long, stout, vertical, locked together, almost cylindrical, rough with transverse wrinkles, and having a dull lustre; the fang rather short and bent.

Lip not longer than wide.

Palpus rather long, somewhat slender; (♂) the tarsus scarcely longer than the metatarsus, but little swollen, with the extremity directed downward, and with a moderately large bulb.

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[1]In all the species described by Keyserling under this genus the quadrangle is wider than long.

Legs: patella and tibia of the third shorter than those joints in the fourth pair; metatarsus and tarsus of the fourth somewhat shorter, or more often as long as patella and tibia of the fourth. Spines on all the legs, those on the metatarsi of the fourth throughout their length.

In this genus the relative length of the legs is very variable. In the species described by Thorell (Studi Ragni, III, pp. 526-642) we find the following formulæ: ♂ 1, 3, 4, 2; 3, 4, 1, 2; 3, 1, 4, 2; 1, 3, 2, 4, $\overline{3\ 4}$ 1 2; 1, 2, 3, 4; ♀ 3, 4, 1, 2; 1, 4, 3, 2; $\overline{1, 4, 3, 2}$. The same is true of the height of the clypeus. In these species the height varies from less than $\frac{1}{4}$ to $\frac{1}{3}$, to $\frac{1}{2}$ and in one spider almost equals the diameter of the large middle eyes.

[1] ZENODORUS N.

Syn.: 1881. Ephippus THORELL, Studi sui Ragni Malesi e Papuani, III, p. 643.

1883. " KEYSERLING, Arachniden Australiens, p. 1422.

Cephalothorax high, on both sides in front, especially in the male, dilated and inflated.

Clypeus at least half as high as diameter of middle eyes. Quadrangle of eyes usually occupying $\frac{1}{3}$ of the length of the cephalothorax, nearly equally wide in front and behind, about a quarter wider than long, and narrower than the cephalothorax at that place by three or four times the diameter of the posterior eyes. The line bordering on the upper edges of the anterior eyes is more or less strongly curved upward; the lateral anterior eyes separated by less than their diameter from the large middle eyes, eyes of the second row almost in the middle between the anterior lateral and the posterior eyes; posterior eyes further from the lateral borders than from each other.

Sternum rather short, wider than the coxæ, not projecting between the coxæ of the first pair.

Falces vertical, ordinary.

Maxillæ parallel, sub-ovate, at least half longer than the lip.

Legs: third pair longer than the others (except in some males which have the first leg longer than the others), much longer than the fourth pair; patella with the tibia of the third longer than patella with the tibia of the fourth. (In the males the first pair of legs is enlarged, and densely haired, at least underneath.)

Abdomen sub-ovate.

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[1] *Zenodorus* is substituted for *Ephippus*, the latter name being preoccupied.

Spinnerets ordinary: the second joint of the superior, wider than long, and obtuse.

Type: Z. d'Urvillei (Walck.).

EURYATTUS THORELL. 1881.

Euryattus THORELL, Studi sui Ragni Malesi e Papuani III, p. 660.

Cephalothorax short, dilated anteriorly, not high.

Clypeus very low, not $\frac{1}{4}$ of the diameter of the middle eyes.

Eyes small; quadrangle very short, about twice as wide as long, and a little wider behind than in front. The anterior row usually curved upward, the middle eyes widely separated, the lateral eyes separated from the middle eyes by their own diameter; eyes of the second row a little further from the posterior eyes than from the anterior lateral eyes; the posterior eyes are placed much higher than the lateral anterior eyes, and are as far or farther from each other as from the lateral borders.

Sternum not much wider than the coxae, not projecting between the coxae of the first pair.

Falces ordinary, sub-vertical.

Maxillae parallel, sub-ovate; lip longer than wide, rather widely truncated at the apex.

Legs those of the first pair longer than the others; the third pair not much longer than the fourth; tibia with the patella of the third longer than tibia with patella of the fourth. The tibiae have spines above; the posterior metatarsi have spines throughout their length.

Abdomen sub-ovate.

Spinnerets: ordinary, the second joint of the superior one being the shortest.

Type: E. porcellus (Thor.).

By the greater space, says Thorell, between the anterior middle and lateral eyes and by the line which touches the upper borders of the first row of eyes being straight and by the lowness of the clypeus this genus is easily distinguished from Ephippus Thorell.

PHIDIPPUS C. KOCH. 1846.

Syn.: 1846. **Phidippus** C. KOCH, Die Arachn., 13, p. 125.
1850. " ID., Uebers. d. Arachn.-Syst., 5, p. 53.
1864. **Crytonota** (sub.-gen. Phidippus) SIM., H. N. d. Araignées, p. 324 (*ad partem*).
1877. **Phidippus** THORELL, On Araneae of Colorado, Bull. U. S.
1878. " TACZ., Les Aranèides de Pèrou, Bull. de. la. Sociètè Impèriale des Naturalistes de Moscou, LIII, 4, p. 333.

Eyes: The first row rather strongly bent, the two middle eyes moderately large, somewhat smaller than is usual, near together, the outer ones in diameter scarcely half as large, placed somewhat away from the middle eyes. The eyes of the third row nearly as large as the outer eyes of the first row, on little hills; the eyes of the second row very small, near to the outer eyes of the first row.

Mandibles stout, standing away from each other toward the extremity, wrinkled transversely, somewhat shining; the fang nearly as long as the upper part of the mandible, strong and bent.

Palpus: That of the female rather long, not stout, entirely of the customary shape, well covered with long hairs; the male palpus moderately stout, shorter jointed, the tarsus oval, thick, bent, the bulb projecting strongly in front.

The species belonging to this genus are all handsome, the mandibles of all having more or less metallic reflections. The head is high, the sides dilated with a short angular plate. The thorax is short and steeply sloping, in most examples, when not rubbed one notices upright brushes or fringes of hair between the upper eyes. The abdomen is rather large in the female, but in the male narrower than the cephalothorax. The spinnerets do not stand far forward. The legs are rather stout, the two first legs the longest, particularly long in the male; the second and fourth pairs are about equally long, the fourth being a little the longer; the third pair is the shortest.

PHILÆUS Thorell 1870. Simon.

Syn.: 1837. **Dendryphantes** C. Koch, Uebers. d. Arachu, Syst., 1, p. 31 (ad partem).
1837. **Calliethera** Id., ibid., p. 30 (ad partem).
1846. **Philia** Id., Die Arachn., XIII, p. 54, 56.
1846. **Phidippus** Id., ibid., p. 125 (ad partem).
1846. **Plexippus** Id., ibid., p. 93 (ad partem).
1869. **Attus** Sim., Monogr. d. Attid, p. 6 (16), 14 (24) (ad partem).
1869. **Dendryphantes** Id., ibid., p. 168 (634), (ad partem).
1870. **Philæus** Thorell, on Europ. Spid., I, p. 217 (♂).
1870. **Attus** Id., ibid., p. 218 (♀).
1876. **Philæus** Sim., Arachn de France, III, p. 45.
1877. " Keyserling, Spinnen aus Uruguay. Vienna, 1877 78. p. 617.
1878. " Lebert, Die Spinnen der Schweiz, p. 305.
1879. " L. Koch, Arachniden Australiens, p. 1080.
1880. " Karsch, Arachnol. Blätter VIII, Zur Kenntniss der attitden, *in* Zeitsch, f. d. Naturwissensch, LIII, p. 397.

Cephalothorax very high; thoracic part dilated, at least a third the longer; cephalic part plane or slightly convex, inclined, limited by a very weak transverse stria.

Clypeus less than half as wide as the middle eyes.

Eyes of the face rather unequal, in a moderately curved line; the middle not touching; the lateral separated by an interval equal to half their diameter. Dorsal eyes almost as large as the lateral, scarcely further apart. Quadrangle at least a third wider than long. Dorsal eyes equally distant from each other and from the lateral borders.

Sternum long, rather narrow. Anterior coxae separated by the width of the lip, thicker than the others.

Falces robust, longer and often a little oblique in the males.

Palpus (♂) very slender: patella and tibia equal or the latter the longer, tarsus oval, narrow, obtusely truncated at the extremity.

Legs. (♂) 1, 2, 4, 3, (♀) 4, 1, 3, 2. Anterior pairs more robust. Tibia and patella of the first male almost as long, female shorter than the cephalothorax; male tibia longer, female tibia and patella equal; tarsus and metatarsus more slender and shorter than the tibia and patella. Tibia and patella of the third much shorter than tibia and patella of the fourth; tarsus and metatarsus of the fourth plainly shorter than patella and tibia (sometimes of the same length in the males). Metatarsus of the fourth armed with spines to the base. Tibia of the fourth cylindrical and parallel.

SIMAETHA Thorell. 1881.

Simaetha Thorell, Studi Sui Ragni Malesi e Papuani III, p. 520.

Cephalothorax short, high, the dorsum strongly convex longitudinally, above, toward the middle dilated and very wide, in front moderately wide, posteriorly very perceptibly narrower.

Clypeus low.

Eyes: area occupying about $\frac{2}{5}$ of the length of the cephalothorax; the quadrangle very wide, much wider than long, wider behind than in front; anterior row of eyes curved upward; middle eyes not touching, separated from the lateral eyes by an interval at least equal to their diameter; eyes of the second row further from the posterior eyes than from the anterior lateral eyes; posterior eyes not further from the lateral borders than from each other.

Sternum scarcely or not wider than the coxae of the first pair; these coxae separated by less than the width of the lip.

Legs (♂) 1, 4, 2, 3; rather robust, without many spines; legs of the first pair more robust than the others, femora compressed anteriorly and and strongly bent above; tibia with patella of the fourth leg longer than tibia with patella of the third.

Abdomen short.

Spinnerets as usual, superior longer and more slender than the inferior; with two joints, which are sub-cylindrical, about as long as wide.

Type: S. thoracica.

This genus, says Thorell, agrees with Philaeus in the distance between the middle and lateral eyes of the first row, but differs from it especially in the form of the cephalothorax; in the latter respect it approaches Bellus (C. L. Koch) and Homalattus (White), but differs from them since the quadrangle of the eyes only occupies $\frac{2}{5}$, not $\frac{1}{2}$, the length of the cephalothorax.

[1] THYENE SIMON, 1885.

Syn.: 1850. **Plexippus** C. Koch, Uebers d Arachn.-Syst. 5, p. 51 (ad partem.)
1869. **Attus** Sim., Monogr. d. espèces Europ. de la fam. d. Attides, p. 14, (24) (ad partem).
1871. " Id., Révis d. Attid.
1876. **Thya** Id, Arachn. d. France, III, p. 51.

Cephalothraax but slightly elevated; thoracic p rt ve y strongly dilated and rounded, at least a third the longer; cephalic part plane and inclined, not limited behind; a very short and fine longitudinal stria between the dorsal eyes.

Eyes of the face very unequal, forming a line slightly curved; the median eyes not touching; the lateral eyes separated by an interval almost as wide as their diameter. Dorsal eyes scarcely smaller than the lateral. much further apart, since the sides of the head diverge behind; these eyes p ojecting widely above; quadrangle at least a third wider than long; dorsal eyes further from one another than from the lateral borders. *Clypeus* about half the diameter of the middle eyes.

Sternum elongated, contracted in front; anterior thighs separated by the width of the lip; the two anterior pairs (particularly the first), the thickest; the fourth a little longer than the third.

Legs (♂) 1, 3, 4, 2; (♀) 4, 3, 1, 2; first pair the most robust; femur compressed and claviform; tibia and patella very thick and cylindrical, male as long, female shorter than the cephalothorax, male tibia a little longer, female tibia and patella equal. Tibia and patella of the third at least as long as patella and tibia of the fourth (only by the greater length of the patella). Tarsus and metatarsus of the fourth a little shorter than the tibia and patella. Tibia of the fourth cylindrical and parallel. Short, robust, conical tibial and metatarsal spines on the two first pairs, forming inferior rows; spines equally short, more slender, and not serial on the posterior parts; metatarsus of the fourth provided with spines throughout the length.

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[1] *Thyene* is substituted for *Thya*, the latter name being preoccupied.

Falces robust, short, conical and vertical in both sexes.

Palpus rather slender; tibia and patella almost equal; tarsus oval; narrow.

AMYCUS C. KOCH. 1846.

Syn.: 1846. Amycus C. KOCH, Die Arach., 13, p. 182.
1878. " TACZ, Araneides du Pérou, Bull. de la Soc. Imp. des Nat. de Moscow LIII, 4, p. 345.
1880. " L. KOCH Arachniden Australiens, p. 1170.

Eyes: the first row is high over the mouth and strongly bent, the two middle eyes large, the side eyes in diameter not half as large. The eyes of the third row just as large as the side eyes of the first; those of the second row very small, half way between these two.

Mandibles very long, nearly equally thick, somewhat curved on the inner corner of the extremity, toothed, the fang rather large.

Palpus: that of the male slender, the second joint bent, the third cylindrical, plainly longer than the fourth, the tarsus long in front, swollen, the bulb covered from above.

Cephalothorax short and very high, falling steeply from the cephalic plate, rather flat, with distinct elevations at the eyes; also the face is very high, but not equally high in the different species, and the first row of eyes high above the mouth. The abdomen is somewhat longer than the cephalothorax, narrow, oblong oval, and equally with the cephalothorax, (the latter, however, only partially) covered thickly with scaly hairs. The spinnerets are slender and rather long, the legs also are long; of these the third pair is the longest, then follows the first, then the second and after this the fourth.

One of the species described by C. Koch and all the Australian species described by L. Koch under this genus have the eyes of the second row nearer the anterior than the posterior side eyes and the legs 1, 3, 2, 4, not 3, 1, 2, 4. See note by Dr. Koch, p. 1170 of the Arachniden Australiens. The species placed in this genus by Dr. L. Koch seem to us (judging by his plates) to belong to at least two if not three different genera.

ASARACUS C. KOCH. 1846.

Asaracus C. KOCH, Die Arachn., XIII, p. 188.

Eyes form and position as in Phidippus.

Palpus of the male slender, rather long, the second joint long gently, slightly bent, the third and fourth short, not longer than thick, the tarsus moderately long, humped at the proximal end, somewhat raised in knots, in the middle on the back somewhat contracted, the bulb covered from above.

Falces very stout, very iridescent, large, strong, convex in front, the sides somewhat widened into a corner, standing away from each other at the extremities, with a long, strong fang.

This genus has a likeness to the genus Amycus; but the palpus, and particularly the falces are differently shaped; also the third pair of legs is not so long as the last pair. The first pair was broken, in the only example that up to this time has come under my observation. Head, thorax, and abdomen agree with those of the above mentioned genus.

LIGONIPES Karsch. 1878

Ligonipes Karsch, Diagn. Attoid. aliquot nov. Novae Holl., *cet.*, *in* Mittheil. d. Münchener Entom. Ver., 1878, p. 26.

Cephalothorax more than twice as long as wide, not high, level.

Eyes of the third row not far in front of the middle of the cephalothorax.

Legs of the first pair remarkable: femora, patellae, and tibiae very much dilated, compressed, the tibiae having stiff short hairs on the inner side, their form being that of a hoe. Second, third and fourth pairs more slender.

Abdomen narrow.

LIGURINUS Karsch. 1878.

Ligurinus Karsch, Diagn. Attoid. aliquot nov. Novae Holl., *cet.*, *in* Mittheil. d. Münchener Entom. Ver., 1878. p. 27.

The genus Ligurinus is much like genus Hyllus C. Koch, and yet is easily distinguished from it; the forehead is a little higher than the anterior eyes, and is so widely ornamented with dense oblique hairs that if the cephalothorax is looked at from above the eyes are entirely hidden.[1]

LYCIDAS Karsch. 1878.

Lycidas Karsch, Diagn. Attoid. aliquot nov. Novae Holl., *cet.*, *in* Mittheil. d. Münchener Entom. Ver., 1878, p. 25.

Cephalothorax high, gradually descending in three parts, cephalic part level. Posterior part sloping obliquely, rounded on the sides.

Eyes: quadrangle wider than long; eyes of the first row touching, the lateral being about a quarter smaller than the middle eyes, but a little larger than the eyes of the third row; eyes of the second row the smallest of all.

Clypeus: middle eyes of the first row distant from the margin of the clypeus by a space which nearly equals their diameter.

Legs: anterior legs short, robust; posterior legs more slender, those of the third pair longest.

Abdomen looked at from above, almost triangular, pointed behind.

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[1] The presence of dense hairs ornamenting the forehead, would seem to be so completely *adaptive* a characteristic as scarcely to be a sufficient basis upon which to found a genus.

MARATUS KARSCH. 1878.

Maratus KARSCH, Diag. Attoid. aliquot nov. Novae Holl., *cet., in* Mittheil. d. Münchener Entom. Ver., 1878, p. 27.

Cephalothorax not long, high.

Eyes: those of the third row, a little in front of the middle of the cephalothorax. Eyes of the second row half way between the posterior and the anterior lateral eyes. Quadrangle of the eyes a little wider in front than behind.

Legs slender.

Abdomen flat, with parallel sides, quadrangular, longer than wide. Body hairy.

MOPSUS KARSCH, 1878.

Syn: 1878. **Mopsus** KARSCH, Diagn. Attoid. aliquot nov, Novae Holl., *cet. in* Mittheil d. Münchener Entom. Ver, 1878. p. 31.

1881. " THORELL, Studi sui Ragni Mal. e Pap., III, p. 462.

Mopsus is very like the genus Ascyltus in appearance, but the clypeus is not dilated on the sides, is higher and not so wide, grows a little narrower above, and is covered above on the anterior cephalic margin and on the sides, with long, slender hairs.

Cephalothorax: Cephalic part higher and shorter than in Ascyltus. Thorax sloping obliquely behind the dorsal eyes.

Eyes: Those of the first row curved backward, touching, placed below the frons. Those of the second row placed further from the lateral eyes and a little within the quadrangle.

Falces nearly perpendicular to the face.

The species placed by Koch & Keyserling (Archinden Australiens, p. 330) in this genus were subsequently made the basis of the genus Sandalodes, Arachniden Australiens, p. 1476.

ASCYLTUS KARSCH. 1878.

Syn: 1878. **Ascyltus** KARSCH, Diagn. Attoid. aliquot nov. Holl.. *cet. in* Mittheil. d. Münchener Entom. Ver., 1878, p. 29.

1881. " L. KOCH and KEYSERLING, Arachniden Australiens, p. 1319.

Cephalothorax not high, rounded, wider in front, narrow behind, cephalic part not inclined.

Clypeus transversely vertical on the sides, somewhat extended, forming an acute angle, dilated, the extreme edge of the dilatation ornamented with some long hairs.

Eyes of the first row placed in front of the forehead. Quadrangle wider than long.

Falces nearly straight; (♀) rounded, smaller. (♂) longer, a little flattened bove, sharp on the edges, diverging.

Legs:[1] first and second pairs more robust and longer than the others; third and fourth pairs more slender, shorter, having spines.

Abdomen narrower than the cephalothorax; elongated.

Spinnerets long.

HYLLUS (C. Koch). 1846. Keyserling.

Syn: 1846. Hyllus C. Koch, Die Arachn., xiii, p. 161.
1846. Deineresus White, Ann. and Mag. of Nat. Hist., 18. p. 179.
1877. Hyllus Thorell, Studi Ragni Malesi e Papuani, I, p. 258.
1878. " Id.,ibid II, p. 264.
1878. " Tacz., Aranéides du Pérou Bull. Soc. Imp. des Nat. de Moscou, LIII, 4, p. 336.
1882. " L. Koch and Keyserling, Arachniden Australiens, p. 1339.

Cephalothorax low and flat, a fifth longer than wide, much wider at the third row of eyes, rounded behind, convex on the back.

Clypeus one fourth as wide as the large middle eyes

Eyes of the face in a line a little curved backward, lateral half as large as the middle eyes and separated from them. Eyes of the second row further from the dorsal than from the lateral eyes. Quadrangle wider than long, equally wide in front and behind, placed before the middle of the cephalothorax. Eyes of the third row further from each other than from the lateral borders.

Sternum moderately convex, a third longer than wide.

Falces large, long, somewhat curved, diverging; the fang very long, somewhat fine, very pointed; on the inner side, before the bent point, a little corner.

Maxillæ rounded at the extremity.

Lip more than half as long as the maxillæ, growing narrower toward the extremity.

Palpus (♂) slender, almost filiform, the second joint the longest and somewhat bent; the third and fourth equally long, both conical; the last joint bent; the bulb covered from above.

Legs (♂) 1, 2, 4, 3, (♀) 1, 4, 2, 3; the first legs much longer and thicker than the others, which are nearly equal. Patella with tibia of the third not longer than patella with tibia of the fourth; metatarsus with the tarsus of the fourth shorter than patella with tibia. Metatarsus of the fourth with spines throughout its length.

[1] Ascyltus pencillatus Karsch, has the legs (♂) 1, 4, 3, 2, (♀) 4, 1, 3, 2. L. Koch and Keyserling, Arachniden Australiens, p. 1319.

ICIUS Simon. 1873.

Syn.: 1850. Marpissa C. Koch, Uebers. d. Arachn.-Syst., 5, p. 47 (ad partem).
1850. Icelus Id., ibid, p. 55.
1869. Attus Sim., Monogr. d. Attid., p. 14 (24) (ad partem).
1870. Marpessa Thorell, on Europ. Spid., I, p. 213 (ad partem).
1871. Attus Sim., Révis. d. Attid.
1873. Icius Id.
1876. " Id., Arachn. de France, III, p. 54.
1877. " Keyserling, Spinnen aus Uruguay. Vienna, 1877–78, p. 621.
1878. " Thorell, Studi Ragni Malesi e Papuani, II, p. 232 (ad partem).
1879. " L. Koch, Arachniden Australiens, p. 1127.
1881. " Thorell, Studi Ragni Malesi e Papuani, III, p. 461 (ad partem.)

Cephalothorax rather elongated; thoracic part parallel, or very slightly enlarged, at least a third the longer; cephalic part plane, slightly elevated, often inclined, limited by a transverse depression which is straight or slightly bent forward.

Clypeus scarcely a quarter as wide as the large middle eyes.

Eyes of the face very unequal, touching, or the lateral ones a little separated, forming a straight line. Dorsal eyes as large, or almost as large as the lateral, a little further apart since the sides of the quadrangle diverge very slightly behind; quadrangle only a quarter wider than long; dorsal eyes much further from each other than from the lateral borders.

Sternum contracted in front, scarcely wider than the intermediate thighs. Anterior thighs separated by the width of the lip, much thicker than the others; thighs of the second and third pairs equal, those of the fourth a little longer.

Falces (♀) short, rather thick, almost square, vertical; (♂) longer, a little inclined forward, their external border presenting an elevated, longitudinal ridge.

Palpus (♂) slender; tibia shorter than the patella, provided with a small superior external apophysis; tarsus narrow and long.

Legs (♂) 1, 4, 3, 2; (♂) 4, 1, 3, 2; those of the first pair more robust; tibia and patella at least a quarter shorter than the cephalothorax; tibia the longer, and slender. Tibia and patella of the fourth much longer than the tibia and patella of the third; tarsus and metatarsus, male, almost as long, female, sensibly shorter tibia and patella. Tibia of the fourth scarcely a quarter longer than the patella, cylindrical, and a little more slender at the extremity. Spines short, rather robust,

and serial on the tibia of the first; slender and very far apart on the second, third and fourth legs; metatarsi of the third and fourth having only terminal spines.

SANDALODES Keyserling. 1883.

Syn.: 1882. **Mopsus** Keyserling, Arachniden Australiens, p. 1333 (ad partem).
1882. **Acompse** Id., Arachniden Australiens, p. 1336 (ad partem).
1883. **Sandalodes** Id., " " p. 1476.

Cephalothorax scarcely a fifth longer than wide, moderately high, rounded on the sides, considerably wider than the third row of eyes, becoming gradually smaller behind and in front, ascending steeply from the posterior margin to the third row of eyes, the cephalic part sloping forward. The middle line is just behind the third row of eyes; the *clypeus* is one fourth as wide as the anterior middle eyes.

Quadrangle of the eyes wider than long, as wide in front as behind, reaching only to the first third of the cephalothorax. The first row moderately bent, and the eyes rather near together. The eyes of the second row half-way between the posterior and the anterior lateral eyes. The posterior eyes further from each other than from the lateral borders.

Falces vertical, not diverging, and short.

Maxillæ widely separated at their extremities, only a third longer than the lip.

Lip longer than wide.

Sternum long and narrow, narrower than the coxæ of the second pair.

Legs, 1, 4, 3, 2; all set with spines, the first pair thicker than the others. Patella and tibia of the third shorter than patella and tibia of the fourth; metatarsus and tarsus of the fourth also shorter than the patella and tibia of the fourth; metatarsus of the fourth with spines throughout its length.

Abdomen fully twice as long as wide.

This genus has great similarity to Icius, and is distinguished from that genus principally by its narrow sternum.

BAVIA Simon. 1877.

Syn: 1877. **Bavia** Simon. Amm. Soc. Entomol. de France, (5), vii. pp 60–62.
1879. **Acompse** L. Koch. Arachniden Australiens, p. 1352.

Cephalothorax not very long; thoracic part a little longer, not dilated rounded; cephalic part plane, but slightly elevated, almost a regular quadrangle; the swellings above the eyes strong.

Eyes of the face very unequal, almost touching, in a straight line. Dorsal eyes as large as the lateral, not further apart since the sides of the head are straight.

Clypeus scarcely a third as wide as the middle eyes.

Sternum scarcely wider than the intermediate thighs. Anterior coxae separated by the width of the lip, much longer and more robust than the others.

Falces rather short, a little projecting, not ridged.

Lip twice as long as wide.

Legs (♂) 4, 1, 2, 3, those of the first pair much more robust; patella and tibia of the first as long as the cephalothorax, tibia much longer than patella; patella and tibia of the fourth much longer than patella and tibia of the third, much more slender; tarsus and metatarsus of the fourth a little shorter than patella and tibia; patella and tiba of the third equal; tibia of the fourth much longer than the patella; trochanters of the fourth long and diverging. On the first pair two inferior rows of short and robust tibial and metatarsal spines; on the second pair a single row of two internal tibial spines coming near together at the top; on the third pair two rows of lateral spines; the anterior having a single one, the posterior two; all the patellae, the metatarsi of the third and fourth, and the tibia of the fourth completely unarmed.

This genus is near *Maevia* and *Icius*; it is distinguished from them by the form of the cephalothorax, of which the cephalic part is relatively much longer, and by the posterior legs, which lack spines on the tibiae and metatarsi.

MAEVIA (C. Koch) 1848. Simon.

Syn.: 1848. **Maevia** C. Koch, Die Archn., XIV, p. 69 (ad partem).
1876. " Sim., Archn. de France, III, p. 60.
1877. " Thorell, Studi Ragni Malesi e Papuani, I, p. 241 (ad partem).
1878. " Tacz., Aranéides du Pérou, Bull. Soc. Imp. des Nat. de Moscou, LIII, 4, p. 227.
1880. " Karsch, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitsch. f. d. Naturwissensch., LIII, p. 398.
1881. " Thorell, Studi Ragni Malesi e Papuani, III, p. 467 (ad partem).

Cephalothorax elongated, very high; thoracic part enlarged, at least a third the longer; cephalic part slightly convex, and a little hollowed between the dorsal eyes.

Clypeus narrow, rarely $\frac{1}{3}$ as wide as the large middle eyes.

Eyes of the face very unequal, forming a straight or almost straight line; the middle touching, the lateral well separated. Dorsal eyes as large as the lateral, equally far apart, quadrangle scarcely a quarter wider than long. Dorsal eyes nearer one another than the lateral borders.

Sternum almost rounded, wider than the intermediate coxae. Anterior coxae separated by at least the width of the lip.

Falces (♂) much longer than the face, vertical, parallel, a little diverging only at the extremity, cylindrical, not ridged.

Palpus (♂) short, resembling that of Heliophanus except the femar which is unarmed.

Legs 1, 4, 3, 2; the first and second pairs a little more robust; tibia of the first longer than patella, these two articulations at least as long as the cephalothorax. Tibia and patella of the fourth much longer than tibia and patella of the third; tarsus and metatarsus, male, as long as patella and tibia. Posterior legs having only very few spines a terminal circle only on the metatarsus (sometimes however a pair of median spines on that articulation).

In the species placed by Thorell in this genus (Studi Ragni Malesi e Papuani, III, pp. 467-492) the legs vary as follows: (♂) 2, 1, 4, 3; 1, 4, 3, 2; 4, 3, 1, 2; 4, 1, 3, 2; (♀) 4, 3, $\overline{1, 2}$. The first formula, 2, 1, 4, 3, makes the second leg the longest. Simon in his Arachnides de France, III, p. 1, gives as one of the characteristics of the family Attide, "2d pair of legs never the longest." We find the variation in the clypeus of Thorell's species to run from scarcely $\frac{1}{4}$ to about $\frac{1}{2}$ the height of the large middle eyes.

OPISTHONCUS L. Koch. 1880.

Opisthoncus L. Koch, Arachniden Australiens, p. 1184.

Cephalothorax longer than wide, high, declining toward the posterior, sides moderately rounded, cephalic part slightly contracted in front, having a smooth, low protuberance between the third row of eyes, more or less prominently adorned.

Clypeus very low.

Quadrangle of eyes wider than long, behind and in front equally wide, or behind a little wider. First row of eyes almost straight or slightly curved, middle eyes close to the lower margin of the clypeus, close to each other, and moderately distant from the lateral. Second row of eyes smallest, and from the lateral eyes of the first row less distant than from the eyes of the third row, and placed either not higher, or only a little higher than these; eyes of the third row, more widely separated from each other than from the margin of the cephalothorax.

Sternum long, contracted.

Maxillae long, contracted at the base, dilated toward the anterior; anterior margin rounded.

Labium more than one half the length of the maxillae, contracted toward the anterior, apex truncated.

Legs 1, 2, 4, 3 or 1, 4, 2, 3: 2, 3, 4 of almost equal length. First pair of legs more robust than the others, and in the male much longer than in the female. Patella and tibia of the third pair shorter that these joints in the fourth pair; the patella with the tibia is longer than the metatarsus with the tarsus in the fourth pair.

VICIRIA THORELL. 1877.

Viciria THORELL, Studi Sui Ragni Malesi e Papuani, I, p. 233.

Cephalothorax about a third longer than wide, moderately high.

Clypeus at least half as wide as the anterior middle eyes.

Sternum rather short, not twice as long as wide, wider than the coxae, not projecting between coxae of the first pair of legs, which are separated by at least the width of the lip.

Eyes: those of the first row plainly visible when the cephalothorax is looked at from above; this row slightly curved upward. Middle anterior eyes large, very prominent; the lateral eyes are rather small, and are separated by an interval greater than their own diameter from the middle eyes. Quadrangle of the eyes a little wider in front than behind, not occupying half the length of the cephalothorax, much narrower behind than is the cephalothorax at that place. Eyes of the second row minute, about in the middle, or a little in front of the middle, between the anterior lateral and the posterior eyes. Posterior eyes placed about their own diameter higher than the anterior lateral eyes, and further from the lateral borders than from each other.

Falces directed downward and more or less forward.

Maxillae long, diverging a little, and slightly curved outward, about half longer than the lip; lip nearly half longer than wide, plainly narrowing toward the rounded or sub-truncated extremity.

Palpus slender, in the female neither dilated nor flattened at the extremity.

Legs rather long, slender or moderately stout, first pair, at least in some cases, more robust than the others; third pair (sometimes excepting the first), longer than the others; tibia with the patella of the third longer, or at least not shorter than tibia with patella of the fourth. Tibiae much longer than patellae. Metatarsi of the fourth spined throughout their length.

Abdomen long and slender.

Spinnerets six, long and cylindrical.

Type: V. Pavesii.

Viciria differs from Maevia (Koch) Sim. in the tibia and patella of the third being longer or at least not shorter than the tibia and patella of the fourth, and in the greater prominence of the large middle eyes, and the greater space between them and the lateral eyes.

EPIBLEMUM (HENTZ) 1882. THORELL.

Syn.: 1832. **Epiblemum** HENTZ, On North America Spiders, p. 108 (ad partem).
1837. **Calliethera** C. KOCH, Uebers. d. Arachn. Syst. I, p. 30 (ad partem).
1850. " ID., ibid, 5, p. 45 (ad max. part.).
1864. **Cyrtonota** sub-gen. Calliethera Sim., H. N. d, Araignees, p. 324, 327 (ad part.).
1868. **Calliethera** [Callethera] ID., Monogr. d, espéces Europ. de la fam. d Attides, p. 6 (16) 180 (646 (ad max. part.).
1870. **Epiblemum** THORELL, on Europ. Spid. I, page 210.
1876. " LEBERT, Die Spinnen der Schweiz, p. 297.
1876. **Calliethera** SIM., Arach. de France, III, p. 62.
1883. " " " de l' ocean Atlantique, Ann. Soc. Ent. de France, 1882, p. 261.

Eyes eight, unequal, in three rows, the first composed of four, the two middle ones somewhat larger, the second composed of two very small ones placed nearer the third row, which is composed of two larger ones.

Falces very long, slender, horizontal, in both sexes, fang nearly as long.

Maxillae parallel, wide at base, narrow above the insertion of the palpi, cut obliquely on both sides toward the point.

Lip conical.

Legs 1, 4, 2, 3 or 1, 4, 3, 2.

Type: E Scenicum (faustum) Cl.

When Hentz, in 1832, formed the genus Epiblemum, he founded it on Epiblemum faustum; while Koch in 1837 founded the genus Calliethera on Aranea scenica. E. faustum and A. scenica are undoubtedly identical. This species is probably a comparatively recent importation f om Europe. Hentz is wrong in saying that the falces are horizontal in both sexes. They are vertical in the female of E. faustum.

THIANIA C. KOCH. 1846.

Syn.: 1846. **Thiania** C. KOCH, Die Arachn., XIII, p. 171.
1877. " THORELL, Studi Ragni Malesi e Papuani, I, p. 251.

Eyes of the first row close over the front edge of the head. The two middle eyes of this row very large, occupying nearly the whole height of the head. The eyes of the third row smaller than the lateral eyes of the first row; the small median eyes placed a little beyond the middle, nearer the hind eyes.

Falces of the male somewhat short, rather flat above.

Palpus moderately long and somewhat stout, the two first joints as usual, the third and fourth very short, oval, the small bulb covered from above.

The species belonging to this genus resemble those of the genus Calliethera. Eyes, falces, and palpus, however, make a plain and constant division. The scaly covering of the abdomen is highly colored, taking the form of transverse bands.

HASARIUS Simon. 1871.

Syn.: 1846. **Plexippus** C. Koch, Die Arachn., XIII p. 93 (ad partem).
1850. **Euophrys** Id , Uebers. d. Arachn. Syst., 5, p. 60.
1850. " sub-gen, Maturna ibid., p. 65.
1869. **Attus** Sim., Monogr. d. Attid., p. 14 (24).
1869. **Plexippus** Id., ibid., p. 177 (643).
1870. **Attus** Thorell, on Europ. Spid., I, p. 218 (ad partem).
1871. " Sim., Révis. d. Attid,
1871. **Hasarius** Id., ibid.
1876. " Id., Arachn. de France III, p. 77.
1880. " Karsch, Arachnol. Blätter VIII, zur Kenntniss der Attiden, *in* Zeitsch. f. d. Naturwis ensch. LIII, p. 398.
1881. " L. Koch and Keyserling, Arachniden Australiens, p. 1272.
1883. " Sim., Arachn. de l' Ocean Atlantique, Ann. Soc. Ent. de France, 1882, p. 284.

Cephalothorax rather long, high. Thoracic part sensibly dilated, at least a third the longer. Cephalic part slightly convex and inclined, limited by a very faint depression, which is straight or bent forward.

Eyes of the face rather unequal, forming a line very slightly curved; the middle eyes scarcely separated, the interval of the lateral, wider. Dorsal eyes a little smaller or as large as the lateral, a very little further apart, since the sides of the quadrangle diverge a little behind; quadrangle at least a third wider than long; dorsal eyes a little further from each other than from the lateral borders.

Clypeus usually wider than half the middle eyes, with thick hairs.

Sternum elongated, rather narrow. Anterior thighs separated by the width of the lip; all the thighs longer than wide, those of the first pair thicker and sometimes longer than the others, which are almost equal.

Legs usually (♂) 1, 3–4, 2; (♀) 3–4, 1, 2; the first and second pairs more robust, with femoral joints compressed. Tibia and patella of the first a little shorter than the cephalothorax, these two articulations equal, or the tibia a little the longer; tarsus and metatarsus shorter, more slender, almost of the same length. Femora of the third and fourth equal; tibia and patella of the third a little longer than tibia and patella of the fourth or often of the same, length. Tarsus and metatartus of the fourth of the same length as the tibia and patella. Tibia of the fourth parallel, or slightly enlarged at the extremity. Femoral, tibial, and metatarsal spines on the four pairs; metatarsus of the fourth with spines throughout its length.

Falces as long or longer than the face, vertical, often deep set[1] in both sexes, never ridged.

Palpus (♂) robust and short (except H. Adausoui); tibia shorter than patella and provided with external apophyses; tarsus longer than the preceding articulations and wide (except H. Adausoni); bulb simple, reaching almost the extremity of the tarsus; hook rarely apparent.

The species described by Messrs. Koch and Keyserling under this genus have the following variations in the leg formula: female, 1, 2, 3, 4; 1, 2, 3, 4; 1, 4, 3, 2; 1, 3, 4, 2; 1, 2, 3, 4; 4, 3, 1, 2; 4, 3, 1, 2; male, 1, 2, 3, 4; 1, 3, 2, 4; 1, 3, 4, 2; 1, 4, 3, 2; 1, 4, 3, 2; 1, 4, 3, 2; 4, 3, 1, 2; 4, 3, 1, 2; 3, 4, 1, 2; 4, 1, 3, 2. In the same species the clypeus varies in height from $\frac{1}{5}$ to $\frac{1}{2}$ the large middle eyes. It is interesting to note that while in the species described by Keyserling there seems to be a very constant relation between the length of the whole body and the longest pair of legs, the length of the longest legs being only very little greater or less than the total length, H. chrysostomus, male, has its total length 7 mm., and its longest leg 11.6 mm. H. vittatus, male, a fair representative of the other species, has its total length 4.2 mm., and its longest leg 3.8 mm. The greater proportional length of the longest legs in H. chrysostomus is correlated with other structural modifications which seem to separate it from the other species of this genus. The same remarks are applicable also to H. lautus.

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[1] The French word is "renfoncée."

PELLENES Simon. 1876.

Syn : 1850. Euophrys: sub. gen. Pales C. Koch, Uebers. d. Arachn.-Syst., 5, p. 64.

1869 Attus Sim., Monogr. d. espéces Europ. de la fam. d. Attides p. 14 (24) (ad partem.)

1870 " Thorell, On Europ. Spid. I., p. 218 (ad partem).

1871 " Sim., Revis d. Attid.

1876. Pellenes Sim., Arcahn. de France, III, p. 90.

Cephalothorax rather long, high; thoracic part distinctly dilated, at least a third the longer; cephalic part sightly convex; inclined, limited by a depression which is bent forward.

Eyes of the face rather unequal, forming a line which is straight or slightly curved forward; the middle eyes but little separated; the interval of the lateral eyes wider. Dorsal eyes a little smaller than the lateral and further apart, since the sides of the quadrangle diverge behind. Quadrangle about a third wider than long. Dorsal eyes further from one another than from the lateral borders.

Clypeus at least half as wide as the middle eyes.

Stermum long; anterior thighs separated by the width of the lip and thicker than the others; the lateral almost equal, longer than wide.

Legs (♂) 1, 3, 4, 2; (♀) 3, 1, 4, 2; first legs much the most robust, with compressed femora; tibia and patella of the first shorter than the cephalothorax; male, these two articulations equal; female, tibia a little the longer, tarsus and metarsus more slender and shorter than the two preceding articulations. almost equal. Femur, patella, and tibia of the third much longer and a little thicker than the femur, patella and tibia of the fourth; tarsus and metarsus of the fourth generally a little shorter than the patella and tibia of the third strongly enlarged, from the base of the extremity tibia; tibia of the fourth almost parallel or a little enlarged. Femoral, tibial and metatarsal spines on the four pairs, very short, and serial on the tibiae and metatarsi of the first and second; metatarsus of the fourth, with spines to the base.

Falces as long, or a little shorter than the face. Vertical or inclined backward in both sexes.

Palpus (♂) robust and short; tarsus oval, wider and at least as long as the two preceding; bulb generally simple, reaching almost the end of the tarsus; tibia shorter than the patella, provided with a superior external apophysis, directed forward, usually received into a little depression of the tarsal border and hidden from above.

ERGANE KEYSERLING. 1881.

Ergane KEYSERLING, Arachniden Australiens, p. 1260.

Cephalothorax longer than wide, a little wider in the middle than in front, behind rounded, above high and convex, sloping in front.

Clypens less than half the diameter of the large eyes.

Quadrangle ofeyes wider than long, placed before the middle of the cephalothorax, as wide in front as behind. Dorsal eyes from one another and from the margin of the cephalothorax almost equally distant. Small median eyes half way between the dorsal eyes and the lateral eyes of the first row. First row of eyes curved.

Sterum oblong.

Falces short and touching.

Maxillae dilated in front, not twice longer than the lip.

Legs spined. 1–3, 4, 2, 3, 1, 2, 4, 1, 4, 3, 2, or 4, 3, 1, 2. Legs of the first pair a little stouter than the others. Patella and tibia of the third longer than the patella and tibia of the fourth. The fourth pair has the metatarsus and the tarsus longer than the patella with the tibia.

Abdomen ovate, longer than wide.

Spinnerets, inferior and superior equally long.

PHYALE C. KOCH. 1846.

Syn.: 1846. **Phyale** C. KOCH, Die Arach., XIII, p. 193.
1878. " TACZ., Aranéides du Pérou, Bull. Soc. Imp. des Nat. de Moscou, LIII, 4, p. 315.

Eyes of the first row bent, the two middle eyes nearly touching, very large, close over the front edge of the head, the side eyes of this row in their diameter not half so large as the middle eyes; the eyes of the third row somewhat smaller than the outer eyes of the first row and almost forming a square with them; the eyes of the second row unusually small, half way between the eyes of the third row and the outer eyes of the first row.

Falces short, stout, swollen, shining, scarcely longer than thick, fang not long.

Palpus of the female of the customary form, somewhat covered with short hair; that of the male unknown.

All high colored beautiful little spiders. The head is flat above and rather long, the cephalothorax usually nearly as long as wide; the sides of the cephalothorax are gently rounded, and steeply falling; the head is not much higher than the middle eyes in front, the clypens being narrow and somewhat retreating. The abdomen is usually oval, almost always rather

short, not thicker than cephalothorax. Cephalothorax and abdomen are closely covered with scaly hairs above, these giving the color. The spinnerets are very short. The legs are moderately long, the first and second pairs being the shortest, but the stoutest, usually having the femur thickened; they are about one and a half times as long as the thorax; the third pair somewhat exceeds the second in length, and the fourth is plainly longer than the second; above, the first joints, and in part the tipiae are covered with brightly colored scaly hairs; the hair of the other joints is fine and light, and the spines very fine.

JOTUS KEYSERLING. 1881.

Jotus KEYSERLING, Arachniden Australiens, p. 1243.

Cephalothorax about one-fifth part longer than wide, in front a little more contracted than in the middle, rounded behind, above high and convex.

Clypeus less than half the diameter of the large eyes.

Quadrangle of eyes wider than long, equally wide in front and behind and not occupying half the length of the cephalothorax. Anterior eyes near together, forming a row slightly curved upward. Small median eyes half way between the dorsal eyes and the lateral eyes of the first row. Dorsal eyes almost as far from each other as from the margin of the cephalothorax.

Sternum slightly convex, ovate, much longer than wide.

Falces short and diverging, in front commonly plane.

Maxillae rather long, in front dilated and rounded.

Labium more than half the length of the maxilla.

Legs moderately long, spined, 4, 3, 1, 2, or 4, 1, 3, 2, or 1, 4, 3, 2. First pair a little stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth. The fourth pair has the metatarsus and tarsus not longer than the patella and tibia.

Abdomen longer than wide, rounded in front, behind pointed.

Spinnerets rather long, inferior and superior equally large and long.

HABROCESTUM SIMON. 1876.

Syn.: 1869. **Attus** SIM., Monogr. d. espéces Europ. de la fam d. Attides. p. 14 (24) (ad partem).
1871. " ID,, Revis. d. Attid.
1876. **Habrocestum** ID., Arachn. de France, III, p. 131.
1882. " KEYSERLING, Arachniden Australiens, p. 1401.

Cephalothorax rather short, very high; thoracic part often convex, but slightly dilated on the side, only a third the longer. Cephalic part slightly convex, very much inclined, limited by a faint depression which is straight or bent forward.

Eyes: those of the face, rather unequal, but little separated, forming a line straight or slightly curved forward. Dorsal eyes a little smaller than the latteral, not further apart, little or not at all prominent above; quadrangle scarcely a third wider than long; dorsal eyes almost equally distant from each other and from the lateral borders. *Clypeus* about half as wide as the middle eyes.

Sternum small, long. narrower than the intermediate thighs. Interval between the anterior thighs less than the width of the lip at the base.

Legs 3, 4, 1, 2; the first legs like those of Æ lurops. Femur, patella and tibia of the third much longer than the same articulations in the fourth pair. Tibiae of the third and fourth much enlarged from the base to the extremity and a little compressed. Tarsus and metatarsus of the fourth as long as patella and tibia.

Falces weak, scarcely as long as the face, vertical or obliquely directed backward in both sexes.

Palpus short and robust as in Ælurops.

HELIOPHANUS (C. Koch.) 1833. Simon.

Syn.: 1833. **Heliophanus** C. Koch, *in* Herr.-Schaeff, Deutschl. Ins., 119, 1, 2.

1837. " Id., Uebers. d. Arachn.-Syst., p. 29.

1864. " [**Heliophana**] Sim., H. N. d. Araignees, p, 332.

1868. " Sim., Monogr., d. espéces Europ. de la fam. d. Attides, p. 6 (16), 201 (667).

1868. **Callethera** [**Calliethera**] Id., ibid., p. 6 (16), 180 (646) (ad partem).

1870. " Thorell, Europ. Spid. I, p. 211.

1876. " Sim., Arach. de France, III, p. 140.

1878. " Lebert Die Spinnen der Schweiz, p. 298.

Cephalothorax high; thoracic part dilated, at least a third the longer. Cepholic part slightly convex, a little inclined, limited by a depression which is usually wide, straight, or bent backward; thoracic part presenting indistinct diverging striae.

Clypeus scarcely one fourth as wide as the large middle eyes, without hairs.

Eyes of the face very unequal in a straight or slightly curved line; dorsa eyes a little smaller than the lateral and not further apart. Quadrangle a third or a quarter wider than long.

Sternum wider than the intermediate coxae, often unequal. Anterior coxae separated by the width of the lip at the base.

Falces rather robust, vertical, never ridged.

(♂) *Maxillae* wide at the extremity; their superior external angle presenting one or two conical projections.

(♂) *Palpus* short; femur, robust, armed below with a simple or bifid apophysis; patella long and a little convex; tibia shorter armed with external apophyses, slender and slightly developed; tarsus narrow and elongated, terminating in a point, projecting beyond the bulb.

Legs 4, 1, 2, 3, or 4, 1, 3, 2, slightly unequal. Tibia and patella of the first shorter than the cephalothorax; metatarsus more slender than tibia and patella of the fourth. Patella (alone) of the third as long and often a little more robust than patella of the fourth; tibia of the fourth almost parallel and cylindrical. Femoral, tibial, and metatarsal spines on the four pairs; no patellary spines.

CYRBA Simon. 1876.

Syn.: 1869. **Attus** Sim., Monogr. d. espéces Europ. de la fam. d. Attides, 14 (24) (ad part)

1871. " Id., Révis d. Attid.

1876. **Cyrba** Id., Arachn. d. France, III, p. 165.

1883. " Keyserling, Arachniden Australiens, p. 1436.

Cephalothorax but slightly elevated; thoracic part not dilated, a little contracted, about a third the longer; cephalic part plane, inclined, limited by a very faint transverse depression, cut by a longitudinal stria.

Eyes: those of the face very unequal, almost touching, forming a straight line. Dorsal eyes scarcely smaller than the lateral, not prominent, and not further apart. Quadrangle almost a third wider than long; dorsal eyes further from each other than from the lateral borders. *clypeus* very narrow, with hair.

Sternum oval, wider than the intermediate thighs. Anterior thighs separated by at least the width of the lip; thighs of the fourth longer.

Legs 4, 1, 3, 2; first pair much more robust, particularly the femur and the tibia. Tibia of the first a little longer than the patella; the two articulations shorter than the cephalothorax; tarsus and metatarsus more slender and almost as long as the two preceding articulations. Tibia and patella of the third much shorter than the tibia and patella of the fourth. Tibia of the fourth almost parallel; tarsus and metatarsus of the fourth as long or almost as long as tibia and patella. Femoral, tibial and metatarsal spines on the four pairs; two patellary spines on the two posterior pairs.

Falces rather weak, vertical, of the same length as the face.

Palpus (♂) femur slender; tibia with apophyses; tarsus oval. (♀) Tibia and patella a little dilated; tarsus pointed.

The species placed by Keyserling in this genus have the legs 4, 3, 1, 2, or 4, 3, $\overline{12}$.

[1] ÆLURILLUS Simon. 1885.

Syn.: 1850. **Euophrys** (Sub-gen. Dia) C. Koch, Uebers. d. Arachn. Syst., 5, p. 64.
1869. **Attus** (6th gr.) Sim., Monogr. d. espèces Europ. de la fam. d. Attides, p. 54 (44).
1870. **Ælurops** Thorell, on European Spiders, I, p. 219.
1871. **Attus** (6th gr.) Sim., Rèvis d. Attid.
1876. **Ælurops** Id., Arachn. de France, III, p. 134.
1876. " Lebert, Die Spinnen der Schweiz, p. 309 (ad partem).

[2] *Cephalothorax* very high; thoracic part strongly dilated, twice as long as the cephalic. Cephalic part slightly convex, inclined, limited by a slight transverse depression, generally straight.

Clypeus as wide or almost as wide as the middle eyes.

Eyes of the face rather unequal, well separated, particularly the lateral, in a line so much curved that a straight line from the top of the middle eyes cuts the lateral eyes below the center. Dorsal eyes smaller than the lateral, further apart. Quadrangle at least a third (often more) wider than long. Dorsal eyes as near or nearer to one another as to the lateral borders.

Sternum long, very narrow, particularly in the males. Anterior coxae separated by about the width of the lip. Coxae of the first, second, and third pairs equal in length and thickness, and a little longer than wide; coxae of the fourth a little longer than the others.

Falces not very robust, shorter than the face, inclined backward in both sexes.

Palpus (♂) short and thick; femur compressed; patella and tibia short and almost equal; tibia always with two small superior external apophyses; tarsus wider, oval and a little compressed, passing beyond the bulb.

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[1] *Ælurillus* is substituted for *Ælurops*, the latter name being preoccupied.

[2] This is Simon's definition of the genus Ælurops Thorell.

Legs 3, 4, 1, 2, or 3,4, 1, 2, rarely 4, 3, 1, 2. The two anterior pairs shorter and more robust; tibia and patella of the first equal and much shorter than the cephalothorax: tarsus and metatarsus almost equal, a little (scarcely in the males) shorter than the patella and tibia. Femur patella and tibia of the third, of the same length or scarcely longer than the same articulations in the fourth pair. Tibia of the third (and of the fourth, though less) enlarged from base to extremity; tarsus and metatarsus of the fourth as long as patella and tibia. Femoral, tibial and metatarsal spines on the four pairs; patellary spines on the third and fourth. Metatarsus of the fourth with spines to the base.

YLLENUS Simon. 1869.

Syn.: 1869. Yllenus Sim., Monogr. d. Attid., 166 (632).
1870. " Thorell, On Europ. Spid., I, p. 219 (ad partem).
1876. " Sim., Arachn. de France, III, p. 127.
1878. " Lebert, Die Spinnen der Schweiz, p. 313 (ad partem).

Cephalothorax rather long; very high; thoracic part strongly dilated, twice as long as the cephalic. Cephalic part slightly convex, inclined, limited by a very slight depression.

Clypeus almost as wide as the middle eyes, with thick hairs.

Eyes of the face quite unequal, well separated, particularly the lateral forming a line strongly curved, the summit of the middle eyes being on a level with the center of the lateral eyes, or very slightly higher. Dorsal eyes smaller than the lateral, and further apart, not prominent. Quadrangle at least a third wider than long; dorsal eyes further from each other than from the lateral borders.

Sternum short, narrower than the intermediate coxae. Interval between the anterior coxae not quite so wide as the lip. Anterior coxae thicker than the others; second, third and fourth coxae equal in thickness; fourth coxae longest.

Falces weak, shorter than the face, vertical in both sexes.

Palpus short, very robust and massive; patella and tibia well developed tarsus relatively small, often compressed and raised into a ridge.

Legs 4, 3, 1, 2; first and second pairs shorter and much more robust, particularly the first; tibia and patella of the first equal, and much shorter than the cephalothorax: tarsus and metatarsus equal and much shorter than patella and tibia; femur, patella and tibia of the third much shorter than the same articulations of the fourth pair. Tibia of the fourth a good deal enlarged from base to extremity, and compressed; tarsus and metatarsus of the fourth much shorter

than patella and tibia; trochanters of the fourth leg very long, visible from above. Femoral, tibial and metatarsal spines on the four pairs: patellary spines on the third and fourth; metatarsus of the fourth with spines to base.

Integument entirely covered with thick pubescence.

Nearest Ælurops Thorell, agreeing with that genus in having the upper part of the frons so prominent that the anterior eyes are hidden from above; and differing from it in that the tibia of the fourth leg is at least as long as the metatarsus with the tarsus.

SAITIS Simon. 1876.

Syn.: 1869. **Attus** (gr. 10) Sim., Monogr. d. espèces europ. de la fam. d. Attides, p. 96 (562).

1876. **Saitis** Sim., Arachn. de France, III, p. 168.

1877. " Thorell, Studi sui Ragni Mal. e Pap. I, p. 225.

1882. **Thorellia** L. Koch and Keyserling, Arachniden Australiens, p. 1352.

1883. **Saitis** Id., ibid., p. 1434.

Cephalothorax moderately long, almost parallel; thoracic part a third the longer, not dilated; cephalic part plane and a little inclined, limited by a very slight depression.

Clypeus very obliquely inclined, scarcely half as wide as the middle eyes.

Eyes of the face very unequal, scarcely separated, in a straight line. Dorsal eyes very convex, scarcely smaller than the lateral, and a little nearer together. Quadrangle a third wider than long; dorsal eyes further from each other than from the lateral borders.

Sternum moderately wide, contracted in front. Anterior coxae separated by the width of the lip; fourth coxae a little the longest.

Falces a little shorter than the face, and narrower, not robust, and inclined.

Legs (♂) 3, 4, 1, 2; the first and second pairs almost equal and much shorter than the others; (♀) 4–3, 1, 2. Tibia and patella of the first a third shorter than the cephalothorax and almost equal, of the same length as the tarsus and metatarsus which are equal. (♂) Femur, patella, tibia and metatarsus of the third longer and much more robust than those of the fourth pair, ornamented with long hairs, which are very thick and disposed in longitudinal lines; (♀) third and fourth legs a little more alike. Tibia and patella of the fourth a little longer than the metatarsus, tibia of the fourth longer than the patella, parallel and cylindrical. Very long femoral, patellary (♀ on the posterior pairs), tibial and metatarsal spines; on the fourth pair metatarsal spines throughout the length of the articulation.

ATTUS (WALCK.) 1805. SIMON.

Syn.: 1805. **Attus** WALCK., Tabl. d. Aran. p. 22 (ad partem).
1850. **Europhrys** C. KOCH, Uebers. d. Arachn. Syst., 5, p. 60 (ad partem).
1869. **Attus** SIM., Monogr. d. espèces europ. de la fam. d. Attides, p. 6 (16), 14 (24), (ad partem).
1870. " THORELL, On Europ. Spid., I, p. 218 (ad partem).
1870. **Elurops** ID., ibid. p. 219 (ad partem).
1871. **Attus** SIM., Révis. d. Attidae (ad partem).
1876. " ID., Arachn. de France, III, p. 101.
1877. " THORELL, Studi sui Ragni Malesi e Papuani, I, p. 280 (ad partem),
1878. " ID., ibid. II, p. 290 (ad partem).
1878. " LEBERT, Die Spinnen der Schweiz, p. 306 (ad partem).
1881. " THORELL, Studi sui Ragni Malesi e Papuani, III, p. 509 (ad partem).

Cephalothorax high; thoracic part a little dilated, a third, or only a quarter (*A. saltator*) the longer. Cephalic part plane or a little convex, inclined forward, limited by a slight depression which is straight or slightly bent.

Clypeus equal to half the large middle eyes, or a little narrower, rarely wider (*A. floricola* ♂).

Eyes of the face rather unequal, a little separated, at least the lateral, and usually in a slightly curved line; dorsal eyes usually a little smaller than the lateral, as far or a little further apart; quadrangle scarcely a third wider than long; dorsal eyes equally far or a little further from each other than from the lateral borders.

Sternum elongated, as narrow as the intermediate coxae (except *A. attellanus* ♂).

Falces weak, vertical, as long or shorter than the face.

Palpus normal.

Legs 4, 1, 2, 3, rarely 1, 4, 2, 3; remarkable for the pre-eminence of the second pair over the third. Tibia and patella of the first as long (*A. Wagœ, frigidus*) or most often shorter than the cephalothorax; (♀) these two articulations equal; (♂) tibia longer; tarsus and metatarsus more slender (except *A. cingulatus*) and shorter (often barely) than the two preceding articulations. Fourth legs much longer than the third in all their articulations, principally the femur and the tibia; tibia at least a third longer than the patella, slightly enlarged from the base to the extremity and a little compressed; tarsus and metatarsus of the fourth much shorter than the patella and tibia (except some males: *A. floricola*, etc.). Femoral, tibial and metatarsal spines on the four pairs and throughout the length of the articulations.

PHLEGRA Simon. 1876.

Syn.: 1850. **Euophrys** (sub-gen. Parthenia) C. Koch, Uebers. d. Arachn.-Syst. 5, p. 65.
1869. **Attus** (9th gr.) Sim,, Monogr. d. espèces Europ. de la fam. d. Attides, p. 85 (551).
1870. **Ælurops** Thor., On European Spiders, I, p. 219 (ad partem).
1871. **Attus** (10th gr.) Sim.; Rèvis d. Attid.
1876. **Phlegra** Id., Arachn. de France, III, p. 120.

Cephalothorax very long, parallel in the cephalic part, a little dilated beyond; thoracic part at least twice the longer. Cephalic part plane and inclined not, or barely limited behind.

Eyes: those of the face very unequal; the middle eyes almost touhcing; the lateral a little separated, forming a line almost straight, or perceptibly curved. Dorsal eyes a little smaller than the lateral eyes, not, or very slightly further apart. Quadrangle a quarter wider than long; dorsal eyes a little further from one another than from the lateral borders.

Clypeus always more than half as wide as the middle eyes, often fully as wide (♂), with hairs.

Sternum contracted in front, at least twice as long as wide, as wide or slightly wider than the intermediate thighs. Anterior thighs separated by the width of the lip; thighs of the first, second and third legs almost equal; those of the fourth longer.

Legs 4, 1, 3, 2, or 4, 3, 1, 2. Tibia and patella of tha first at least a quarter shorter than the cephalothorax, these two articulations being equal in length and thickness, and a little longer than the tarsus and metatarsus, the latter being equal and more slender. Femur, tibia and patella of the fourth much longer than those of the third pair, exactly of the same length as the tarsus and metatarsus; tibia of the fourth much longer than the patella, slightly enlarged and compressed at the extremity. Posterior metatarsi armed to the base with very long spines.

Falces vertical or obliquely inclined backwards, shorter than the face in both sexes.

OEDIPUS Menge. 1877.

Syn.: 1869. **Attus** Sim., Monogr. d. Attid., p. 6 (16) 14 (24) (ad partem).
1876. **Ballus** Id., Arachn. de France, III, p. 201 (ad partem).
1877. **Oedipus** Menge, Preussische Spinnen, IX, p. 482.

Cephalothorax oblong; higher than wide between the dorsal eyes; the convex cephalic part inclined forward, the hind part descending abruptly. The forehead and large middle eyes are so oblique that from directly above only the upper margin of the eyes is visible.

The *clypeus* is still more oblique.

Eyes like those of Dendryphantes.

Legs also like Dendryphantes except that the femur and tibia of the first pair are more robust. Number of claw-teeth small.

Palpus (♂) with a sharp apophysis on the inner side of the fourth joint. The palpal tube makes a single turn and then passes into the sac like bulb. The point of the hook lies on a small tongue-shaped leaf.

Epigynum (♀) closely resembling D. rudis; the openings of the spermathecal tubes lie on the inner half of the chitinous arched enclosure, and end, after many turnings, close to the outer half of the orifice.

Spinnerets like those of Dendryphantes.

The species live in moss under fallen leaves and bushes.

SCARTES Menge. 1877.

Scartes Menge, Preussische Spinnen, IX, p. 494.

Cephalothorax oblong; the cephalic part with the forehead widely projecting; higher than wide, rounded on the sides, sloping steeply behind, the margin marked with a slight furrow.

Clypeus strongly retreating.

The large middle anterior *eyes* stand forward, the lateral anterior in a curve, somewhat removed from them. The small median eyes and the hind side-eyes stand rather on the side than on the top of the head.

The *palpus* (♂) has on the lower edge of the inner side of the second joint a deep-lying hook shaped apophysis with one small and one large tooth at the end. The fourth joint has on the inner side a short leaf-like apophysis; the fifth joint is long and has a small oval depression for the palpal organ, and the forepart long and curved over, the end of the palpal organ has four rounded corners, and is extended at one corner into a long awl-shaped projection, which consists of the palpal tube (Eindringer) and the covering which accompanies it to the very point. The awl-shaped projection is at one place narrowed; the palpal-tube passes, after a short winding course, into the sack-like bulb.

I have found the female only in the immature stage, where the epigynum shows only two openings for the future spermathecal tubes.

Abdomen oval. The whole body finely haired.

Legs 4, 3, 1, 2, with long slender claws and two pairs of spines on the metatarsi of both first legs.

Spinnerets with small tubes.

They live under heath plants.

EUOPHRYS (C. KOCH) 1834. SIMON.

Syn.: 1834. **Euophrys** C. KOCH, *in* Herr.-Schaeff., Deutschl. Ins., 123. (ad part.:) 7, 8.
1837. " ID., Uebers. d. Arachn.-Syst., 1, p. 33 (ad partem).
1848. **Attus** ID., Die Arachn., XIV, (ad part.:) p. 44-49.
1850. " ID., Uebers. d. Arachn.-Syst., 5, p. 68 (ad partem).
1869. " SIM., Monogr. d. Attid., p. 6 (16), 14 (24) (ad partem).
1870. **Euophrys** THORELL, on Europ. Spid., I, p. 216, (ad partem).
1871. **Attus** SIM., Revis. d. Attid. gr. 15 (ad partem).
1876. **Euophrys** ID., Arachn. de France, III, p. 170.
1878. " LEBERT, Die Spinnen der Schweiz, p. 302.
1878. " TACZ, Araneides du Perou. Bull. Soc. Imp. des Nat. de Moscou, LIII, 4, p. 280.
1883. " L. KOCH and KEYSERLING, Arachniden Australiens, p. 1430.
1883. " SIM., Arachnides de l'Ocean Atlantique, Ann. Soc. Ent. de France, 1882, p. 261.

Cephalothorax rather high; thoracic part dilated, a third or a quarter longer than the cephalic which is usually plane, little inclined, limited by a badly defined impression, cut by a small, very short longitudinal stria; thoracic part often having some diverging striae faintly indicated.

Clypeus half the middle eyes, or wider, with, usually, sub-ocular, and longer buccal hairs; the latter are often rooted in a membranous part which separates the border of the clypeus from the falces.

Eyes of the face very unequal, forming a straight, or rarely, a slightly curved line; dorsal eyes of the same size, or a little smaller than the lateral, not or scarcely projecting, and not further apart, since the sides of the square are straight: square a quarter wider than long: dorsal eyes further from one another than from the lateral borders.

Sternum oval, usually wider than the interme diate coxæ. Anterior coxæ separated by at least the width of the lip: coxæ of the fourth pair longest.

Falces weak, vertical or incl ned backward (renfoncees), shorter than the face.

Legs 4, 3, 1, 2 or 4, 1, 3, 2, rarely 1, 4, 3, 2. First and sometimes seco .d pairs more robust than the others, particularly in the males, the femora being compressed and claviform. Patella and tibia of the first almost always shorter than the cephalothorax and slightly unequal: tarsus and metatarsus shorter and more slender than the two preceding articulations. Tibia and patella of the third (together) a little, (often scarcely) shorter than the tibia and patella of the fourth; tibia of the

third much shorter, and a little thicker, than tibia of the fourth; patella (alone) longer than patella of the fourth; tarsus and metatarsus of the fourth as long or scarcely shorter than patella and tibia; tibia of the fourth, slightly enlarged at the extremity and a little compressed. Femoral, tibial, and metatarsal, but no patellary spines.

ALCMENA C. KOCH. 1846.

Syn.: 1846. Alcmena C. KOCH, Die Arachn., XIII, p. 176.
1880. " KARSCH, Arachnol. Blätter VIII, Zur Kenntniss der Attiden, *in* Zeitsch. f. d. Natur Wissensch., LIII, p. 397.

Eyes of the first row as in Euophrys. The eyes of the third row plainly smaller than the outer eyes of the first row, and further removed from them, the eyes of the second row very small, nearer to the outer eyes of the first row than to the eyes of the third row.

Falces in the male large, convex, smooth, twice as long as the face; in the female smaller.

Palpus without distinctive characteristic.

This genus stands very near to the genus Euophrys, but the position of the eyes and the large falces separate it essentially. Moreover the cephalothorax and abdomen are thinner, that is to say narrower and longer, and also are covered closely with shining scales, which give the color and marking. The female palpus has nothing unusual; that of the male I know only from young animals with immature bulbs; these are not different from those of Euophrys.

[1] HYPOBLEMUM. N.

Syn.: 1882. Acmaea KEYSERLING, Arachniden Australiens, p. 1420.
1883. **Drepanephora** ID., Arachniden Australiens, p. 1477.

Cephalothorax one-third or one-fourth longer than wide, sensibly contracted toward the front, behind rounded, wider at the dorsal eyes, rather low, slightly convex above.

Clypeus low.

Quadrangle of Eyes, wider than long, in front moderately contracted, not reaching the middle of the cephalothorax. First row of eyes curved upward; the lateral are separated by half their own diameter from the large eyes. Dorsal eyes are further from one another than from the margin of the cephalothorax, small median eyes are half way between the lateral anterior and the dorsal eyes.

Falces short.

Maxillae dilated and rounded in front.

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[1] *Hypoblemum* is substituted for *Drepanephora*, the latter name being preoccupied.

Labium contracted toward the front, a little longer than wide, scarcely longer than half the length of the maxilla.

Sternum convex, one third longer than wide, toward the posterior dilated.

Legs spined, 3, 4, 2, 1. Fourth pair more slender than the others. Patella and tibia of the third longer than the patella and tibia of the fourth; metatarsus and tarsus of the fourth not longer than the patella and the tibia, metatarsi spined throughout their length.

Abdomen sub-ovate, twice as long as wide.

Spinnerets moderately long, superior and inferior of equal length.

SELAOPHORA Keyserling. 1882.

Selaophora Keyserling, Archniden Australiens, p. 1374.

Cephalothorax not high, about one-third longer than wide, contracted in front, behind wide and rounded, scarcely wider than the dorsal row of eyes, convex above.

Clypeus scarcely as high as half the diameter of the large eyes.

Quadrangle of eyes wider than long, as wide before as behind, situated in front of the middle of the cephalothorax. Anterior row of eyes nearly straight, not touching. Small median eyes a little nearer the dorsal eyes than the lateral anterior. Dorsal eyes further from each other than from the margin of the cephalothorax.

Falces short and not diverging.

Maxillae twice as long as the labium.

Labium contracted in front and not longer than wide.

Abdomen long.

Legs spined 4, 3, 1, 2. Patella and tibia of the third shorter than patella and tibia of the fourth. Metatarsus aud tarsus of the fourth not longer than the patella and tibia.

SOBARA Keyserling. 1882.

Sobara Keyserling, Arachniden Australiens, p. 1365.

Cephalothorax longer than wide, contracted toward the front, rounded behind. moderately high, cephalic part plane,

Clypeus as high as the diameter of the large eyes.

Quadrangle of eyes wider than long, wider behind than in front not so long as the half of the cephalothorax, anterior row of eyes a little curved upward, middle eyes not touching, lateral eyes separated from these; small median eyes half way between the anterior lateral and dorsal eyes; dorsal eyes from each not wider than from the margin of the cephalothorax.

Falces rather long and slender, not diverging.

Maxillae wide at apex, contracted at the base.

Labium contracted in front, longer than half the length of the maxilla margin in front straight.

Sternum plane, rounded.

Abdomen long and contracted.

Legs spined, 1, 4, 2, 3 or 4, 3, 1, 2. First pair of legs scarcely stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth. Metatarsus and tarsus of the fourth not longer than the patella and tibia.

THEROSA KEYSERLING. 1882.

Therosa KEYSERLING, Arachniden Australiens, p. 1413.

Cephalothorax one quarter longer than wide, not contracted in front rounded behind, a little wider at the dorsal eyes, above convex.

Clypeus very low.

Quadrangle of eyes wider than long, wider in front than behind, and placed far in front of the middle of the cephalothorax. Dorsal eyes a little further from one another than from the margin of the cephalothorax. First row of eyes curved, close together; small median eyes half way between the anterior lateral and the dorsal eyes.

Falces short and not diverging.

Maxillae dilated and rounded in front.

Labium rounded in front and half as long as the maxilla.

Sternum twice as long as wide, contracted more in front than behind.

Abdomen long and contracted.

Legs spined 4, 3, 1, 2. First pair not shorter than the others. Patella and tibia of the third as long as the patella and tibia of the fourth; metatarsus and tarsus of the fourth not shorter than the patella and tibia.

MARGAROMMA KEYSERLING. 1882.

Margaromma KEYSERLING, Arachniden Australiens, pp. 1347, 1466.

Cephalothorax one fifth part longer than wide, contracted in front, behind wide and rounded, high above, wider at the dorsal eyes.

Clypeus half the diameter of the large eyes.

Quadrangle of eyes wider than long, forming a trapezium, contracted behind. Dorsal eyes almost as far from each other as from the margin of the cephalothorax. First row of eyes recurved and near to each other. Small median eyes further from the anterior lateral than from the dorsal eyes.

Falces short and not diverging.

Maxillae rather long in front, dilated and rounded.

Labium contracted in front, not more than half the length of the maxilla.

Sternum sligtly convex, a little longer than wide.

Abdomen short and ovate.

Legs spined, 3, 4, 1, 2. First pair not stouter than the others. Patella and tibia of the third a little longer than the patella with the tibia of the fourth. Metatarsus and tarsus of the fourth not longer than the patella and tibia.

PROSTHECLINA KEYSERLING. 1882.

Prostheclina KEYSERLING, Arachniden Australiens p. 1368.

Cephalothorax one fifth longer than wide, contracted in front, a little wider and rounded behind, equally wide at the dorsal eyes.

Clypeus half the diameter of the large eyes.

Quadrangle of eyes scarcely wider than long, behind a little contracted and almost reaching the middle of the cephalothorax. Anterior row of eyes almost straight, eyes close together. Dorsal eyes from each other scarcely further than from the margin of the cephalothorax: small median eyes half way between the anterior lateral and the dorsal eyes.

Falces short, not diverging.

Maxillae dilated and rounded in front.

Labium contracted in front, half as long as the maxilla.

Sternum oval and moderately convex.

Abdomen ovate.

Legs 4, 3, 1, 2 or 1, 4, 3, 2. Patella and tibia of the third as long as the patella and tibia of the fourth.[1] Metatarsus and tarsus of the fourth longer than the patella and tibia.

LAGNUS L. KOCH. 1879.

Lagnus L. KOCH, Arachniden Australiens, p. 1073.

Cephalothorax a little longer than wide, high; lateral and posterior, margins rounded. Cephalic part convex.

Clypeus low.

Quadrangle of eyes in front a little wider than long and wider than behind; first row of eyes recurved, close together, the median very large. Middle eyes equally distant from the lateral anterior and the posterior eyes. Eyes of the third row placed in front of the middle of the cephalothorax and less distant from each other than from the margin of the cephalothorax.

Maxillae dilated toward the front, lateral margin with the anterior margin being lengthened to form an angle.

Lip convex, contracted in front, longer than half the length of the maxilla, lip rounded.

[1] Written "third" but evidently a misprint for fourth.

Sternum hardly longer than wide, plane.

Abdomen long, sensibly narrowed toward the posterior.

Palpi (♂) elongated, equal in length to the first pair of legs.

Legs spined 1, 4, 3, 2, first pair stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth. Metatarsus and tarsus of the fourth evidently longer than the patella and the tibia.

SCAEA L. KOCH. 1879.

Scaea L. KOCH. Arachniden Australiens, p 1142.

Cephalothorax longer than wide, slightly contracted behind, high and convex, toward the anterior declining, third row of eyes high above the sides.

Quadrangle of eyes wider than long, equally wide in front and behind, and placed in front of the middle of the cephalothorax. Middle row of eyes as far from the lateral eyes of the first row as from the eyes of the third row and placed not higher than these; eyes of the third row further from the margin of the cephalothorax than from each other.

Sternum ovate cordate.

Abdomen broadly ovate.

Legs patella with the tibia of the third pair shorter than the same joints of the fourth pair. The metatarsus with the tarsus of the fourth pair are shorter than the patella with the tibia.

[1] BOOTES N.

Syn: 1882. **Hadrosoma** KEYSERLING. Arachniden Australiens, p. 1418.

Cephalothorax short, one-sixth longer than wide, in front not contracted, behind rounded and a little contracted, scarcely wider at the dorsal eyes, above convex.

Clypeus more than half the diameter of the large eyes.

Quadrangle of eyes wider than long, as wide before as behind, almost reaching the middle of the cephalothorax. Dorsal eyes further from one another than from the margin of the cephalothorax. Small median eyes half way between the anterior lateral and the dorsal eyes. First row of eyes slightly recurved and the lateral eyes separated from the middle eyes.

Falces short and not diverging.

Maxillae dilated and rounded in front.

Labium rounded in front, not longer than wide, half as long as the maxilla.

Sternum oval and a little convex.

Abdomen level, a little longer than wide.

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[1] *Bootes* is substituted for *Hadrosoma*, the latter name being preoccupied.

Legs spined 4, 1, 3, 2. First pair not stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth. Metatarsu and tarsus of the fourth not larger than the patella and tibia.

CYTÆA KEYSERLING. 1882.

Cytæa KEYSERLING, Arachniden Australiens, p. 1380.

Cephalothorax one-third or fourth part longer than wide, slightly contracted toward the front, behind rounded, a little wider at the third row of eyes, above slightly convex, not high.

Clypeus a third of the diameter of the large eyes.

Quadrangle of eyes wider than long, behind and in front equally wide or a little narrower behind, placed far in front of the middle of the cephalothorax. Dorsal eyes further from each other than from the margin of the cephalothorax. Anterior row of eyes recurved and more or less close together. Small median eyes half way between the anterior lateral and dorsal eyes.

Falces short and not diverging.

Maxillae dilated and rounded in front.

Labium rounded in front, not more than half as long as the maxilla.

Sternum oval, longer than wide.

Legs spined. 1, 3, 4, 2, or 4, 3, 1, 2; first pair stouter than the others. Patella and tibia of the third longer than the patella and tibia of the fourth; metatarsus and tarsus of the fourth not shorter than the patella with the tibia. Metatarsus of the fourth spined to the apex.

SINNAMORA KEYSERLING. 1883.

Syn.: 1882. Tanypus[1] KEYSERLING, Arachniden Australiens, p. 1415.
1883. Sinnamora ID., Arachniden Australiens, p. 1477.

Cephalothorax about one-fifth longer than wide, toward the posterior moderately dilated, contracted in front, a little wider at the dorsal row of eyes, above high, slanting before and behind.

Clypeus as high as one-fourth the diameter of the large eye.

Quadrangle of eyes wider than long, wider in front than behind, almost reaching the middle of the cephalothorax. First row of eyes recurved, close together. Dorsal eyes less distant from one another than from the margin of the cephalothorax. Small median eyes half way between the anterior lateral and the dorsal eyes.

Falces short, not diverging.

Maxillae dilated and rounded in front.

Labium longer than wide, more than half as long as the maxilla.

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[1] The generic name "Tanypus" was pre-occupied.

Sternum rounded, plane and a little longer than wide.

Abdomen long and contracted.

Legs spined, 4, 1, 3, 2. First pair hardly stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth; metatarsus and tarsus of the fourth a little longer than the patella and the tibia. Metatarsus of the fourth commonly spined throughout its length.

LANUARULLA KEYSERLING. 1883.

Lauharulla KEYSERLING, Arachniden Australiens, p. 1431.

Cephalothorax one-fourth longer than wide, not wider in the middle than in front, scarcely wider at the third row of eyes, high and convex.

Clypeus very low.

Quadrangle of eyes wider than long, a little contracted behind, almost reaching the middle of the cephalothorax. Eyes of the first row close together, slightly curved or almost straight. Dorsal eyes a little smaller than the anterior lateral and further from one another than from the margin of the cephalothorax. Small median eyes are nearer the anterior lateral than the dorsal eyes.

Sternum heart-shaped, scarcely longer than wide.

Falces vertical, short, and not diverging.

Maxillae more than twice as long as the labium.

Labium wider than long, rounded in front.

Legs 4, 1, 3, 2. First pair not stouter than the others. Patella and tibia of the third shorter than the patella and tibia of the fourth. Metatarsus and tarsus of the fourth not longer than the patella and tibia. Matatarsi of the fourth pair spined only at the apex.

Abdomen short, as long as wide.

Spinnerets as usual, superior not longer than the inferior.

ASTIA KOCH. 1879.

Astia L. Koch. Arachn. Australiens, p. 1152.

Cephalothorax contracted in front, wider and rounded toward the posterior, opposite the third row of eyes wider, one quarter longer than wide.

Quadrangle of eyes wider than long, forming a trapezium contracted behind. Third row of eyes as far from one another as from the margin of the cephalothorax. Middle row of eyes nearer the front lateral than the posterior eyes, and placed perceptibly higher than these.

Sternum ovate-cordate.

Abdomen ovate, truncated in front, sensibly contracted toward the apex.

Patella and tibia of third pair shorter than the patella and tibia of the fourth pair. Metatarsus with the tarsus of the fourth pair shorter than the patella with the tibia.

SUB-FAMILY LYSSOMANAE.

LYSSOMANES Hentz. 1832.

Syn.: 1832. Lyssomanes Hentz. Silliman's Journal of Science and Arts XXI pp. 99–152.

1844. " " Journal Boston Soc. Nat. Hist., IV pp. 386–396.

1875. " " Occasional Papers Boston Soc. Nat. Hist. II. The Spiders of the United States, Edited E. Burgess, p. 48.

Cheliceres moderately strong; maxillae parallel, short, rounded.

Lip conical, slightly truncated at tip.

Eyes eight, unequal in four rows, the first composed of two very large eyes the second of two smaller ones, placed farther apart, on a common elevation with the two forming the third, which is narrower, the fourth about as wide, composed of two eyes placed on separate elevations

Feet, first pair largest, then the second, then the third, the fourth being the shortest.

JELSKIA Taczanowski. 1872.

Syn.: 1872. Jelskia Tacz, Aran. de la Guyane française, Horae. Soc. Ent. Rossicae, VIII. 1871, pp. 128–132.

1878 " Id., Aranéides du Pérou, Bull. de la Soc. Imp. des Nat. de Moscou, LIII. 4, p. 373.

Cephalothorax long, with the cephalic part distinct from the thoracic, and higher.

Eyes eight, in four rows: the first pair very large, occupying the entire height of the face, very near together but not touching, directed forward: eyes of the second row half as large, situated above those of the anterior row, a little further back, and separated from each other so as to form an almost regular quadrangle with the anterior eyes; like them directed forward and a little upward: the eyes of the third row small, situated on the horizontal face of the back, nearer to one another than the others, and directed upward; those of the fourth row as large as those of the second, placed behind on the middle of the back, not quite so far apart as these last, directed obliquely backward.

Falces cylindrical, slender, short, and vertical, with the hook short and strongly bent.

Palpus long and slender; the femur as long as the tarsus; the patella and and tibia equal, as slender as the femur, and not so long; the tarsus long, passing considerably beyond the bulb, which is globular, terminating in a curved hook which is coverrd above by the tarsus.

Legs very long, slender, and unequal; relative length 1, 4, 2, 3; the first pair much longer than the others, between which the difference is slight.

Abdomen long, slender, cylindrical, with short spinnerets.

[1] EPEUS N.

Syn: 1877. Evenus Simon, Am. Soc. Entomol de France, (5), vii, pp. 58–58

Cephalothorax moderately long: thoracic part scarcely the longer, plainly dilated and rounded, cephalic part plane, high behind, inclined in front, longer than wide.

Eyes: the median anterior eyes very large, almost touching, the entire width of the face; the lateral eyes much smaller, separated, further back, forming a second line. Dorsal eyes as large as the lateral, a little nearer together since the sides of the head converge behind.

Clypeus almost as wide as the radius of the median anterior eyes.

Sternum scarcely wider than the intermediate coxae, rounded above, anterior coxae separated by at least the width of the lip, of the same length as the others.

Falces short, vertical, not ridged.

Legs 3, 1, 2, 4, long, the three first pairs of equal thickness, the fourth pair more slender, patella and tibia of the first longer than the cephalothorax, tibia much longer than the patella; patella and tibia of the fourth much shorter than patella and tibia of the third, and more slender; metatarsus and torsus of the fourth at least as long as the patella and tibia; on the first two pairs two inferior rows of very long tibial and metatarsal spines; tibae and metatarsi of the two posterior pairs with slender spines throughout their length. Long tarsal claws, regularly bent, the external one provided with a series of five teeth, longer, more slender, equal, crowded together.

This genus makes the transition from the ordinary Attidae to *Lyssomanes* of Hentz.

ATHAMAS Cambridge, 1877.

Syn: 1877. Athamas Cambridge, Proc. Zool. Soc., London, pp. 575-7.
1879. " L. Koch, Arachniden Australiens, p. 1076.

Cephalothorax short, massive, quadrate. Very convex above; the side and hinder slope almost vertical.

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[1] *Epeus* is substituted for *Evenus*, the latter name being preoccupied.

Eyes very unequal in size, disposed in four transverse lines of two each, and almost of same length.

Maxillæ rather short, slighty divergent, and much the broadest at their extremities, which are rounded.

Lip short, small, and of a somewhat curviangular form.

Legs rather slender and moderately long; those of the first pair longest; and of the second pair shortest.

Abdomen small, short, oval, and sloping from its most convex part, near the margin to the spinners.

This genus is closely allied to *Lyssomanes* Hentz, as well as to *Jelskia* Taez. It differs, however, from both in the shortness of the cephalothorax and also of the abdomen. From *Lyssomanes* Hentz it differs in the superior and inferior spinners being of equal length, whereas, in that genus, those of the superior pair are much longer, slender and three-jointed.

Dr. L. Koch's suggestion that Athamas is probably identical with Evenus of Simon (Arachniden Australiens, p. 1076), seems to us an error, since the genera differ in several characteristics. In Cambridge's genus the cephalothorax in front is very *convex*; the sides of the head are *parallel*, the clypeus as *wide* as the middle eyes of the first row; the first leg longest. In the genus of Simon, the cephalic part is *plane*, the sides of the head *converge* behind, the clypeus is only *one-half* the diameter of the large middle eye; the third leg longest.

APPENDIX.

We give below definitions of those genera which have been formed since the completion of the preceding paper. Those of Mr. Simon and Count Keyserling we have translated with their notes. We wish, also, to refer to a genus which had heretofore escaped our notice, and of which we have not yet the definition. This is *Chalcoscirtus* Bertkau, formed for *Calliethera infima* E. Sim., cf. Ver. d. Nat. Ver., XXX, 1883, p. 207.

PSEUDICIUS SIMON. 1885.

Syn.: Attus AUCT (ad part.). Dendryphantes E. Sinn., Ar. Fr., III (ad part. *eucarpatus*, etc.) + Calliethera E. Sim., Ar., Karth., 1884 (ad p. *icioides*). Pseudicius E. Sim, Faune Arach. de l'asie Mérid., Bulletin de la Soc. Zool. de France, t. x. 1885.

Related to the genus *Icius* E. Sim., differing in having the eye area parallel above, and the falces in ♂ and ♀ not grooved in the outer sides; tibiae I and II unarmed, or with one spine (*P. badius*), or provided with two minute spines on the inner side; tibiae and metatarsi III and IV unarmed, (excepting with the ordinary terminal spines); ♂ with femur and tibiae I very stout.

I believe it necessary to create this genus for a certain number of species whose characteristics are intermediate between those of *Icius*, and those of *Dendryphantes* and *Calliethera*, but which does not agree entirely with any one of these. The cephalothorax is long and low as in *Calliethera* and *Icius*, the first row of eyes is equally straight, this being the point which separates these genera from *Dendryphantes*, the ocular quadrangle is parallel above, as in *Calliethera;* the armature of the anterior legs is very peculiar; the tibiae are unarmed with the exception of one or two small internal spines on the first pair, but the metatarsi have two pairs of small spines. The integument is covered with simple hairs, never with scales.

This genus has for its type *P.* (*Dendryphantes*) *encarpatus* Walck.; it includes beside, *P. badius* E. Sim., *P. picaceus* E. Sim , from the south of Europe, and *P.* (*Calliethera*) icioides E. Sim., from Khartoum.

PSEUDAMYCUS Simon. 1885.

Amycus V. Hasselt, (*albomaculatus*) (non C. Koch nec L. Koch).
Pseudamycus E. Sim, Arachn. recueillis par M. Weyers á Sumatra, Ex. des Comptes-rendus de la Soc. Ent. de Belgique, 1885.

Very closely related to the genus *Ephippus* Thorell, the cephalothorax and eyes being almost the same, the falces being furnished with one strong tooth on the inferior margin of the groove, and with two, the second being the smaller, on the superior margin (in *Ephippus* the inferior has 1, and the superior 3 or 4 minute teeth), the metatarsi and tarsi III and IV being a little shorter than the patellae with the tibiae (they are a little longer in *Ephippus*), and the tibiae III and IV armed with a dorsal spine below the base.

The genus *Amycus* C. Koch (type *igneus*), found in South America, is easily distinguished by its clypeus being as wide as, or wider than the anterior eyes, and by the inferior margin of the falces being provided with from 3 to 5 teeth.

PTOCASIUS Simon. 1885.

Ptocasius Sim., Arach. recueillis par M. Weyers, à Sumatra, Ex. des Comptes-rendus de la Soc. Ent. de Belgique, 1885.

Related to the genus *Hasarius*, the cephalothorax being almost the same, but the occular area being a little longer above, scarcely one fourth wider than long, parallel or barely wider behind, convex on both sides behind the eyes; eyes as in *Hasarius* excepting that those of the second row are more widely removed from the posterior than from the anterior eyes; labium more attenuated, falces with a pair of teeth (or a bifurcated tooth) on the inferior margin of the groove, which are very unequal, the first being much smaller than the second, the maxillae in the ♂ denticulated on the outer side behind the corner. Legs as in the genus *Hasarius* but with the tibiae and metatarsi I and II armed on both sides with lateral spines, tibiae I and II without dorsal spines, III and IV with a smaller dorsal spine placed behind the base, integuments covered with simple hairs, not with scales.

Equally near to the genus *Cytaea* Keyserl. (in L. Koch, Ar. Austr.) but differing from it in having the cephalothorax shorter and higher, by the superior margin of the falces being provided with two teeth, as in *Hasarius*, while in *Cytaea* there are four small ones, by the two teeth of the inferior margin being very unequal, and finally by the integument being covered with simple hairs, while the *Cytaea* of the hairs are scale-like.

Salticus sinuatus Doleschall (*Plexippus* Th.), *Plexippus laticeps* Thorell, and probably many other species described by Dr. Thorell under the generic name of *Plexippus* belong to the genus *Cytaea.*

It is probable that several of the species described by Keyserling under the name of *Hasarius,* belong in the genus *Ptocasius,* particularly *lineatus, albocinctus, insularis, chrysostomus,* and *mulciber,* which are unknown to us.

STAGETILLUS Simon. 1885.

Stagetillus E. Sim., Arach. recueillis par M. Weyers á Sumatra, Ex. des Comptes-rendus de la Soc. Ent. de Belgique, 1885.

Near the genus *Bavia,* but having the cephalothorax much longer; the thoracic part almost ⅓ longer than the cephalic, the ocular area longer above, a little narrower behind than in front, the sternum plainly wider than the intermediate coxae, and very much narrower in front, the space between the anterior coxae not narrower than the width of the labium, legs 1, 4, 2, 3, the first much stouter that the others, and compressed, tibiae and metatarsi I and II furnished with stout spines disposed in two inferior rows, the posterior legs unarmed, the metatarsi with the tarsi III and IV longer than the patellae with the tibiae, trochanter IV cylindrical and long, scarcely shorter than the coxae, falces short, parallel, almost plane in front, the inferior margin of the groove with 3 or 4 teeth.

AGOBARDUS Keyserling. 1885.

Agobardus Keyserling, Neue Spinnen aus Amerika, VI, p. 33.

Cephalothorax about ⅕ longer than wide, nearly vertical on the sides, narrower in front and behind, and not wider than the third row of eyes, very convex above, falling steeply to the posterior border, and having the cephalic part strongly inclined forward.

Quadrangle of the eyes equally wide in front and behind, and much wider than long, reaching behind to the middle of the cephalothorax. Looked at from in front the first row of eyes seems to be strongly curved, and the side eyes to be separated from the middle eyes by more than their own radius. The small eyes of the second row are about halfway between the fore side eyes and the eyes of the third row, which are equally distant from each other and from the lateral borders.

Falces a little diverging, and as long and stout as the patellae of the first pair of legs.

Labium not longer than wide, and only half as long as the maxillae, which are rounded in front and moderately wide.

Sternum only a little longer than wide, and plainly wider than the coxae.

Legs (♂ 1, 4, 3, 2, and ♀ 4, 3, 1, 2), moderately long, the first pair scarcely stouter than the others, thinly haired and with spines on all the joints; the metatarsus of the fourth has several at the beginning and end. Metatarsus and tarsus of the fourth a little longer than patella and tibia of the fourth, and these joints as long as the patella and tibia of the third.

Abdomen not much longer than wide.

WALA KEYSERLING. 1885.

Wala KEYSERLING, Neue Spinnen aus Amerika, VI, p. 30.

Abdomen long and slender.

Cephalothorax scarcely wider than long, strongly rounded on the sides, much wider than the third row of eyes, contracted behind, not high above, and rather flat. The cephalic part slightly inclined forward.

Clypeus very low.

Quadrangle of the eyes wider than long, somewhat narrower in front than behind, occupying only about $\frac{1}{3}$ of the cephalothorax. Anterior row slightly bent, with the eyes rather near together. Eyes of the third row further from each other than from the lateral borders.

Falces (♂) rather slender, long, and diverging.

Labium longer than wide, $\frac{2}{3}$ as long as the maxillae.

Sternum scarcely longer than wide and scarcely narrower than the coxae of the first pair of legs, much wider than those of the second.

Legs (♂) 1, 4, 3, 2, first pair in the male much longer and stouter than the others. Femur, tibia, and metatarsus of the first and second pairs with spines, which are found only on the femur and at the extremity of the metatarsus on the third and fourth pairs. Patella and tibia of the fourth longer than the patella and tibia of the third; also longer than the metatarsus and tarsus of the fourth.

This genus stands very near to *Hyllus* C. K., but is separated from it by the still shorter cephalothorax, by the absence of spines at the beginning of the metatarsus of the fourth leg, and chiefly in that the patella and tibia of the third are shorter than the patella and tibia of the fourth, and that the quadrangle of the eyes is a little wider behind than in front. It is also somewhat like *Sandalodes* Keys., but is separated from it by the short, wide sternum, and the absence of spines at the beginning of the metatarsus of the fourth. As to *Mospus Keruli* it offers, beside other differences, the height of the clypeus in relation to the eyes, which is the principal difference. (Bei *Mospus Keruli* bietet ausser anderen Verschiedenheiten die Höhe des Clypeus das am meisten in die Augen tretende Merkmal der Unterscheidung).

GANESA PECKHAM. 1885.

Ganesa PECKHAM, Proc. Nat. Hist. Soc. of Wisconsin, March, 1885.

Cephalothorax very low and flat, slightly contracted in front and behind, twice as long as wide, and a little wider than the third row of eyes, with a depression limiting the cephalic part. Thoracic part twice as long as cephalic, truncated behind.

Eyes forming a quadrangle a little more than $\frac{1}{4}$ wider than long and equally wide in the front and behind. Anterior eyes all separated, forming a line slightly curved [1] downward, the middle nearly three times as large as the lateral eyes. Eyes of the second row halfway between the dorsal and lateral eyes. Dorsal eyes further from each other than the lateral borders.

Clypeus very low.

Sternum wide and oval, narrower behind than in front. Anterior coxae separated by the width of the labium.

Maxillae less than twice as long as labium, wider at the extremity, parallel.

Labium a little longer than wide, rounded at tip.

Falces nearly vertical, not diverging, robust, short, about as wide as long, narrower at the insertion of the fang.

Legs 1, 4, $\overline{2, 3}$, in both sexes. First leg much the stoutest, with the femur and tibia greatly enlarged, and patella slightly enlarged in both sexes. The patella with tibia of the third shorter than patella with tibia of the fourth; metatarsus with tarsus of fourth shorter than patella with tibia. The third and fourth pairs have no spines.

Abdomen long and slender, flattened above.

ASAMONEA (CAMBRIDGE). 1869. SIMON.

Syn., 1869. Asamonea CAMBR., Ann. Mag. nat. hist., 1869, p. 14.
1885. " - E. Sim., Faune Arachnologique de l'Asie Mérid., Bull. de la Soc. Zool. de France, t X., 1885.

We transcribe the following remarks on the genus Asamonea, from E. Simon, (Materiaux pour servir a la faune Arachnologique de l'Asie Méridionale Bulletin de la Société Zoologique de France, t. X, 1885.)

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[1] We speak of the anterior row of eyes as *straight* when a straight line from the top of the middle eyes touches also the top of the lateral eyes; *curved*, when a straight line from the top of the middle eyes cuts the lateral eyes; *curved downward*, when a straight line from the top of the middle eyes passes above the lateral eyes.

The typical species *A. tenuipes* has been described by the Rev. O. P. Cambridge under the generic name of *Asamonea*, but the characters of the genus have never been formulated, the author having been of the opinion, even at the time of its publication, that this new genus was simply synonymous with *Lyssomanes* Hentz. It seems to us that the genus *Asamonea* ought to be re-established, as it differs greatly in reality from the genus *Lyssomanes* by the proportion and the disposition of the eyes and the form of the labium; in *Asamonea* the region occupied by the six dorsal eyes is much wider than long, and the eyes are almost equal, the scarcely smaller ones of the third pair are placed much within and near those of the second, the labium is as wide as long, while in *Lyssomanes* the dorsal ocular area is as long as wide or scarcely wider, the eyes of the third row are much smaller than the others, placed equally far in, but much more behind the eyes of the second row, finally the labium is much longer than wide.

The characters of the genus *Asamonea* may be thus formulated:

Cephalothorax low almost plane above, dorsal eyes 2, 3, 4, occupy a trapeziform area much wider than long, eyes of the third row scarcely smaller than the other eyes, and placed within and behind the eyes of the second row. Maxillae short, almost quadrate. Labium not longer than wide, a little attenuated and truncated. Superior spinnerets much longer than the inferior, biarticulate, the first articulation scarcely shorter than the second. Legs slender, rather long, 1, 4, 2, 3, furnished with long spines; metatarsus IV much longer than the tibiae.

SIMONELLA Peckham. 1885.

Simonella Peckham, Proc. Nat. Hist. Soc. of Wisconsin, March, 1885.

Body long, slender, nodose.

Cephalothorax more than twice as long as wide, convex above, constricted near the middle; thoracic part twice as long as cephalic.

Eyes very unequal in size, placed in four transverse rows of two each. those of the anterior row almost touching. The quadrangle formed by the second and fourth rows is wider behind than in front, and wider behind than long. Eyes of the third row very small, and nearer to the second than to the fourth row. Eyes of the fourth row on the upper margin of the cephalothorax.

Clypeus less than ½ as wide as the anterior eyes, retreating.

Sternum long, narrow behind. Anterior coxae separated by the width of the labium.

Maxillae twice as long as labium, widest in the middle, tapering toward apex.

Labium as wide as long, truncated at tip.

Falces stout and long, vertical, slightly diverging.

Legs 4, 3, 1, 2, slender, differing but little in thickness, the third and fourth pairs unarmed. Patella with tibia of the third shorter than patella with tibia of the fourth; metatarsus with tarsus of the fourth shorter than patella with tibia.

Abdomen long, slender, much narrower in the middle.

Including *Asamonea* Cambr., *Simonella* makes the sixth genus of the sub-family Lyssomanae, which includes those attidae which have the eyes in four transverse rows. *Janus myrmaciaeformis* Tacz. is nearest to *Simonella*, and Dr. Taczanowski, in describing that species, suggests that it ought to constitute a new genus. It differs, however, from *Simonella*, in that the first row of eyes occupies the whole of the face, and in the quadrangle of the eyes being longer than wide. *Simonella* is easily distinguished by its nodose form from the other genera of this sub-family. In general appearance it most resembles *Synemosyna* Hentz.

PROCEEDINGS OF THE ACADEMY SINCE DECEMBER, 1881.

REPORT OF THE SECRETARY.

TWELFTH REGULAR ANNUAL MEETING,

Held at Madison, Wisconsin.

ROOMS OF WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS, CAPITOL, MADISON, WISCONSIN.

FIRST SESSION.

TUESDAY EVENING, December 27th, 1881.

Prof. Davies, General Secretary, read the minutes of the last meetings. Minutes were accepted and adopted.

Profs. W. F. Allen, E. A. Birge, and S. D. Hastings were appointed a committee to whom was referred all nominations for membership.

The Treasurer's report was then read and referred to a committee consisting of Profs. W. F. Allen, A. O. Wright, and R. C. Hindley.

The Treasurer also read the number of years that each member was in arrears for his dues, or also in advance upon his dues in virtue of the arrangement of dues made at the Eleventh Regular Annual Meeting; also the list of members who had failed entirely to respond to the demand for dues, was read.

Professors Butler and Birge and Hon. S. D. Hastings were appointed a committee to consider the legality of the

action of the Academy in appointing Prof. Davies, who has been for nine years General Secretary, and George P. Delaplaine who was for eight years Treasurer, of the Academy, Life Members, in virtue of long continued and unremunerated services in their respective offices.

Academy adjourned until 9 o'clock, Wednesday morning.

SECOND SESSION.

December 28, 1881.

Academy met at 9:30 A. M.

As the Secretary was unable to be present on account of sickness, Prof. A. O. Wright was elected Secretary pro tem.

The committee on nominations reported, recommending the following persons:

Prof. E. G. Smith, Beloit College.

Prof. W. R. Higby, Lake Geneva Seminary.

F. J. Lamb, Esq., Madison.

Prof. R. D. Salsbury, Beloit.

Who were duly elected.

The following report was presented:

To the Wisconsin Academy of Jciences, Arts and Letters:

The committee to whom was referred the constitutionality of the resolution presented at the last Annual Meeting of the Academy, constituting Life Members of the Academy in consideration of some eight years of valuable official service, would respectfully report: that they do not regard the resolution as conflicting with the constitution, and they would therefore recommend its adoption.

Respectfully submitted,

SAMUEL D. HASTINGS,
E. A. BIRGE,
JAMES D. BUTLER.

MADISON, December 28, 1881.

This report was accepted and the resolution making General Delaplaine and Prof. Davies Life Members was then adopted.

The Auditing Committee reported approving the Treasurer's report.

Report adopted.

Report adopted and the names so dropped are:

Prof. W. F. Allen then read a paper on "Land Communities among the Ancient Germans."

Prof. E. A. Birge gave a verbal account of a paper on "The Distribution and Function of the Large Ganglion Cells of the Frog's Spinal Cord."

Prof. J. D. Butler read a paper on "Mediaeal German Schools." Discussed by Prof. O. M. Conover and others.

Prof. A. O. Wright, Secretary of the State Board of Charities and Reforms read a paper on "The Increase of Insanity." Discussed by several.

President Chapin gave a brief address relating to the work of the Academy.

The following resolution offered by the Treasurer was adopted:

WHEREAS, Thirty-one members of the Academy have this morning been suspended from membership, for non-payment of annual dues under the rules of the Academy,

Resolved, That any of the persons thus suspended may be restored to membership at any time by paying into the treasury the amounts due at the time of suspension.

The Academy then proceeded to the election of officers with the following result:

President — Prof. R. D. Irving.

Vice-President of the Department of Science — Professor T. C. Chamberlain, of Beloit.

Vice-President of the Department of Letters — Professor W. C. Sawyer, of Appleton.

Secretary — Prof. E. A. Birge, of Madison.

Librarian — Prof. A. O. Wright, of Madison.

Curator of the Museum — Prof. R. C. Hindley, of Racine.

Treasurer — Hon. S. D. Hastings, of Madison.

Prof. W. F. Allen proposed the following amendment to the constitution, which under the rules lies over until the next meeting.

Resolved, That the constitution be amended so as to abolish the Department of Arts.

The election of Vice-President for the Department of Arts was suspended.

The following resolution offered by Prof. W. F. Allen was adopted:

Resolved, That Secretary, Librarian and Curator compose a committee to have charge of the books and collections of the Academy.

The following resolution offered by Prof. R. C. Hindley was adopted:

Resolved, That the Academy favors and will foster to the best of its ability the establishment of Local, Literary and Scientific societies throughout the state.

Resolution offered by Prof. O. M. Conover was adopted, as follows:

Resolved, That the officers of the Academy be requested to unite with those of the State Historical Society in urging upon the Legislature at its next session the importance of providing a suitable fire-proof building for the use of the Historical Library and the collections of the Academy and of the other State Societies.

Academy adjourned for dinner.

THIRD SESSION.

Wednesday afternoon, 2:30 P. M.

In the lecture room of Natural History of Science Hall, University of Wisconsin.

President Irving in the chair.

The following papers by Rev. S. D. Peet, were read by title:

1. On Animism among the Emblematic Mound Builders.

2. On the Fetichism Exhibited in the Village Sites and Burial Places of Emblematic Mound Builders.

3. On the Tablets and Inscribed Plates of the Mound Builders of Ohio and Iowa compared with Aztec, Persian and Hindoo symbols.

4. The Theory that the Mounds of the Ohio Valley were the Foundations of Communistic Houses Refuted.

A paper was read by Mr. R. D. Salisbury, assistant to Prof. Chamberlin, of Beloit, on "The Dispersion of Drift Copper." Discussed by Professors Irving, Butler and Chamberlain.

Prof. Birge gave an extempore lecture on "Recent Ob-

servations on Nuclear Division and their Relation to Theoretical Zoology."

Prof. Chamberlin then gave an interesting talk on "American Glacial History in the Light of Recent Investigations," and the "Harmony of Certain Observations with Croll's Hypothesis of the Origin of the Glacial Epoch."

Mr. George Schumm, editor of the *Radical Review,* read a paper on "Proportional Representation in Legislation," which was warmly discussed by many members.

The following resolution was adopted:

Resolved, That the General Secretary be requested to prepare a corrected copy of the constitution and by-laws for publication in Volume V of the transactions, and that he also prepare for publication a copy of all resolutions which refer to the management of the affairs of the Academy that will be of general interest to the members.

Academy adjourned.

EVENING SESSION.

Held in the senate chamber of the capitol.

A large audience greeted Prof. Butler, who kept his hearers interested in his description of his "Visit to the Hawaiian Volcano." This paper was followed by a paper on "Human Liberty Empirically Considered," by Dr. John Bascom.

Adjourned.

THIRTEENTH REGULAR ANNUAL MEETING.

Held at Madison, Wisconsin, December 26th, 27th and 28th, 1882.

ROOMS OF THE AGRICULTURAL SOCIETY,
TUESDAY, December 26th, 7:30 P. M.

The Academy was called to order by Pres. Irving.

The minutes of preceding meeting read and approved.

The Treasurer's report was given, as follows:

Balance on hand, 1881	$826 49
Received from annual dues	31 00
Received from life member (G. H. Paul)	100 00
Total	$957 49
Paid out on warrants	70 08
Balance December, 1882	$887 41

The report was referred to Mr. Lamb, Prof. Butler and Dr. Hoy, who reported favorably on it, and it was received and adopted.

The Publishing Committee reported the publication of Vol. V of the Transactions, that the state had furnished $90 for cuts, which sum was sufficient to pay the expenses of those in the volume.

The President and Secretary made brief verbal reports of matters in their respective offices.

The amendment to the constitution abolishing the Department of Arts was lost, (see p. 345).

The matter of publishing Vol. VI was referred to a special committee consisting of Profs. Irving, Wright, Allen and Dr. Hoy, and their report made the order of business for Thursday morning.

Dr. Hoy, Prof's. Allen and Peckham were appointed a committee on nominations.

Mr. S. W. Willard, of DePere, was elected as an annual member.

Capt. John Nader was unanimously elected Vice President for the Department of Arts.

Adjourned.

WEDNESDAY MORNING, 9:30.

President Irving called the Academy to order.

Messrs. C. R. Vanhise and Wm. Trelease, of Madison, were elected annual members.

Voted: that G. D. Swezey, of Doan College, Crete, Nebraska, have twelve copies of Vol. V., of the transactions.

Voted: that Dr. Hoy have six each of Vols. IV and V.

Voted: that parties applying for copies of the transactions be required to pay postage on the same.

Voted: that each contributor be entitled to eight copies of the volume wherein his paper appears.

Voted: that the Secretary prepare and send to each contributor with his proof sheets a blank to be filled out by him, indicating the number of extra copfes of the paper to be printed at the expense of the author.

Voted: that a committee of two be appointed to consider the formation of branch societies, to report Thursday evening.

Dr. Elmendorf and Prof. Emerson appointed as such committee.

The following papers were then read:

"Who Built the Mounds," and "Who made the Copper Tools," by Dr. P. R. Hoy, of Racine.

"The Mound Builders," by Dr. Day, of Wauwatosa. Discussed by Dr. Butler, Prof. Allen and others.

Mr. D. P. Blackstone, of Berlin, elected an annual member.

AFTERNOON SESSION.

2:30 P. M.

Vice President Sawyer in the chair.

Prof. Emerson's paper on Greek Religion was read and discussed.

Adjourned, 4:30.

EVENING SESSION.

Supreme Court Room, 7:30.

President Bascom in the chair.

Paper, "The Unity of Moral Ideas," by Rev. C. Caverno, Lombard, Ill. Discussed by President Bascom and Mr. Richards.

Adjourned.

THURSDAY MORNING.

9:30.

President Irving in the chair.

Messrs. G. E. Brown, Madison, Wis.; D. H. Morgan, Albany, Wis.; R. G. Norton and S. Mills, Madison, Wis., elected annual members.

The committee on publication of Vol. VI reported and their report was unanimously adopted by article as follows:

RESOLUTIONS.

1. The Standing Committee on Publication are authorized to proceed at once to the preparation of Vol. VI of the Transactions of the Academy. Said volume to have its contents arranged according to meetings and not according to departments.

2. The Secretary of the Academy shall be charged with the special duty of overseeing and editing the publication of future volumes of the Transactions.

3. The Transactions of the Academy hereafter published shall contain: (*a*) a list of officers and members of the Academy; (*b*) the charter, by-laws and constitution of the Academy as amended to date; (*c*) the proceedings of the meetings; and (*d*) such papers as are duly certified in writing to the Secretary as accepted for publication in accordance with the following regulations, and no other:

(4.) Hereafter every author of a paper, whether it is to be read by title only, or in full, shall submit, at the time of reading, a brief abstract in writing, of the contents of the paper (not to exceed one half printed page in extent), which abstract shall in all cases be printed in full in the proceedings of the meetings of the Academy; and no paper shall be received for reading that is not accompanied by such abstract. Provided that for Vol. VI. of the Transactions the Secretary shall procure such abstracts of papers hitherto read.

(5.) Papers to be printed in full or in part in the Transactions must be requested of their authors by a Sub-Committee of the Standing Committee

on Publication, which Sub-Committee shall consist of the President and Secretary of the Academy and the Vice-President of the Department in which the paper falls; this Subcommittee to have the authority to request for publication portions only of papers, when it shall deem desirable to them to do so.

(6). In deciding as to the papers to be called for for publication, the committtee shall have spcial regard to its value as a genuine, original contribution to the knowledge of the subject discussed.

(7.) In case the committee shall not feel competent to decide as to the value of a paper, on account of its special or technical character, it shall be their duty to call upon the author to agree with them upon some prominent specialist or specialists, whose opinion as to its value shall be asked, and shall decide the question of its publication.

(8.) These resolutions shall not be construed so as to restrict the present freedom of members in reading papers before the Academy.

(9.) The Sub-Committee on Publication shall be charged with insisting upon the correction of errors in grammar, phraseology, etc., on the part of authors, and shall call the attention of authors to any other points in their papers, which in their judgment appears to need revision.

(10.) The Publishing Committee are authorized to expend not to exceed one hundred dollars for illustrations to Vol. VI of the Transactions.

ROLAND D. IRVING,
W. F. ALLEN,
P. R. HAY,
A. O. WRIGHT,
} Committee.

Papers read:

"The effect of local attractions on the Plumb line and Sea Level," Prof. J. E. Davies, Madison.

"Time and Tide," Capt. John Nader, Madison.

"Nature and Freedom," Prof. J. J. Elemendorf, Racine.

"Sorghum Sugar," M. S. Swenson, M. S., Madison.

Adjourned, 12:30.

AFTERNOON SESSION.

President Bascom in the chair.

Prof. Elmendorf read a paper entitled "The Ideal Man."

Prof. A. O. Wright read a paper on "Pauperism."

Prof. Allen read a paper on "The Sochemanni."

Read by title:

D. P. Blackstone, "The Variations in the attractions due to the figure of the attracting Bodies."

E. A. Birge, "Embryology of Panopaeus Sayi."

THURSDAY EVENING.

7:30 P. M.

President Bascom's paper, "The Universality of Law," read and warmly discussed by many members.

Mr. Lamb was elected chairman of the meeting.

Report of the Committee on Branch Societies was accepted as follows:

Article one favoring the formation of such societies was adopted and the remainder was referred to a committee consisting of the council and Professors Elmendorf and Emerson to report at the next annual meeting.

Voted: that the Secretary of the Academy be and hereby is instructed to convey to the parties of the Supreme Court the thanks of the Academy for their kindness in opening the court room to its meetings.

Voted: that the Publishing committee be authorized to stitch and cover, at the expense of the Academy a sufficient number of the Transactions of each meeting when printed, to supply exchanging societies, if the same shall appear necesssary to said Committee.

Adjourned 9:30.

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Meacham, J. G., Jr., Racine, Wis.
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Dudley, Wm., Madison, Wis.
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Engelman, Peter, Director German and English Academy, Milwaukee.
Feuling, J. B, Ph. D. Prof. Philology, University Wisconsin.
Hawley, C. T.. Milwaukee, Wis.
Lapham, I. A., LL. D., State Geologist, Milwaukee, Wis.
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Safford, T. H., Director Astron. Observatory Williams College, Williamstown, Mass.
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Trumbull, J. H., LL. D., Hartford, Conn.
Van de Warker, Eli, M. D., Syracuse, N. Y.
Verrill, A. E., A. M., Prof. Yale College, New Haven, Conn.
Whitney, W. D., Prof. Yale College, New Haven, Conn,
Winchell, Alex., LL. D., Ann Arbor, Mich.
Winchell, N. H., Prof., Minneapolis, Minn.

HONORARY MEMBERS.

Baird, Spencer F. M., M. D., LL. D., Washington, D. C.
Hamilton, Joseph, Hon., Milwaukee, Wis.

TABLE I.

ANALYSIS OF GENERA OF THE FAMILY ATTIDÆ.

	Height, Length, and Width of Cephalothorax.			Sides of Cephalothorax.					Posterior Part.	Dorsum.	Cephalic Part	Thoracic Part.	Clypeus.
	Height.	Length.	As wide as or wider than 3d row of eyes.	Parallel or not.	Contracted in front or behind.	Dilated in front or behind.	Dilated in or behind the middle.	Vertical or rounded.	Slanting, rounded or truncated.	Plane or convex.	Inclined or level.	Length compared with cephalic part.	Height compared with middle anterior eyes.
Sandalodes	Moderately high.	½ longer than wide	Wider		Both		Middle	Rounded	Slanting		Inclined		
Icius	Not high	Rather long		Sometimes		Sometimes behind				Plane	Often inclined	At least ½ longer	½.
Marpissa		Long					Behind			Plane		At last ½ longer	Scarcely ½.
Epiblemum													About ½.
Philaeus	Very high						Behind middle			Plane or convex	Inclined	At least ½ longer	
Baflus										Plane		Equal to cephalic	
Simætha	High	Short			Both		Middle		Truncated	Convex longitudinally			Less than ½.
Dendryphantes	Moderately high										Level	At least ½ longer	Low.
Artus	High					Behind				Plane or convex	Inclined	½ or ⅔ longer	Less than ½.
Pellenes	High	Rather long				Behind				Convex	Inclined	½ longer	About ½.
Menemerus		Long				Behind				Plane or convex		At least ½ longer	At least ½.
Hasarius	High	Rather long					In and behind middle			Convex		At least ½ longer	Scarcely ½.
Boethus	High	Short			Not in front		Behind middle				Inclined	At least ½ longer	Often more than ½
Aelurillus	Very high		Little wider				Behind middle			Convex	Inclined	Twice as long	About ½.
Yllenus	Very high	Rather long				Behind				Convex	Inclined	Twice as long	As wide or a'most.
Mævia	Very high	Long					Behind middle			Convex	Inclined	At least ½ longer	Almost as wide.
Viciria	Moderately high	½ longer than wide	Much wider									At least ½ longer	Rarely ½.
Bavia	Not high	Not very long						Rounded		Plane		Little longer	At least ½.
Euophrys	Moderately high						Behind middle				Level or incl'd	½ or ⅔ longer	Scarcely ½.
Eris	Moderately high	Short			Behind				Slanting			Equal to cephalic	At least ½.
Neon	N t high				Behind					Plane		Shorter than cephalic	Scarcely ½.
Homalattus	Low						Behind middle			Convex	Level	Much shorter than cephalic	At least ½.
Habrocestum	Very high	Rather short					Middle			Convex	Inclined	½ longer	Much less than ½.
Heliophanus	High										Inclined	At least ½ longer	Moderately high.
Hyctia		Long		Almost	Behind						Level	At least ½ longer	Less than ½.
Cyrba	Not high						Middle			Plane	Inclined	About ½ longer	
Pithyna		Very long		Almost	Behind					Plane	Inclined	At least ½ longer	About ½.
Saitis		Moderately long					Middle			Plane	Inclined	About ½ longer	Scarcely ½.
Neetha	High				Behind					Plane	Inclined	At least twice as long	Scarce ly ½.
Aegon	Not high						Middle	Rounded	Truncated		Inclined	½ longer	Very low.
Plexippus	Moderately high	½ or ⅔ longer than wide					Middle	Rounded		Plane		As long as cephalic	More thin ¼.
Zenodorus	High					In front	Middle	Rounded	Slanting		Inclined	At least ½ longer	Scarcely ½.
Euryattus	Not high	Short	Wider			In front							Almost ½.
Phidippus	High	Short					Middle						About ½.
Cocalus									Slanting				
Lenus	Very high	Not much longer than wide	Little wider					Vertica	Slanting				At least ½.
Hyllus	Low	½ longer than wide	Much wider								Inclined		Not ½.
Ciris		Short							Rounded		Inclined		
Amycus	Very high									Convex	Level		At least ½.
Phyale		Nearly as long as wide							Slanting				½.
Thiania								Rounded			Level		
Charothecin	Low										Level		
Dictynocmus	Moderately high	Long								Plane			Very low.
Diolenius											Level	Shorter than cephalic	
Ascylus	Not high				Behind	In front							
Mogrus	Moderately high												Very low.
Coccorchestes	High								Slanting		Level		
Omoedus	High behind								Truncated				
Rhombonotus		Almost twice as long as wide			Both		Middle		Truncated	Thoracic part convex	Inclined		
Damoetas		Almost twice as long as wide	As wide		Both		Middle	Rounded		Convex	Inclined		High.
Synemosyna													Rather high.
Leptorchestes	Not high			Parallel									About ½
Synageles	Not high	Very long		Parallel									Less than ½.
Agorius	Low	Twice as long as wide			Behind				Rounded or truncated	Plane			
Sulticus	Cephalic part high	Long						Almost vertical	Truncated				Very low.
Schaphora	Not high	½ longer than wide	Little wider		In front	Behind							Very low.
Hyboblemum	Not high	⅓ or ½ longer than wide	Little wider		In front								Less than ½.
Ione		½ longer than wide	Not wider		In front		Middle		Rounded	Convex			Very low.
Therosa		½ longer than wide			In front		Middle		Rounded	Convex			Scarcely ½.
Cytaea	Not high	⅓ or ½ longer than wide			In front		Middle		Rounded	Plane			Low.
Tara	Low	½ longer than wide			In front		Middle		Rounded	Convex			
Lauharulla	High	½ longer than wide		Almost			Middle		Rounded	Convex			Very low.
Parthous	Moderately high	Little longer than wide			Behind		Middle	Rounded		Plane			½.
Sassacus	High	½ nger than wide			In front	Behind		Rounded	Slanting	Convex			Very l.w.
Bianor	High	Little longer than wide	Not wider		Both			Rounded	Slanting	Plane			Very low.
Astia		½ longer than wide			In front	Behind		Rounded			Inclined		Low.
Jotus	High	½ longer than wide			In front		Middle		Rounded	Convex		Not longer	½.
Margonima	High	½ longer than wide			In front	Behind		Rounded	Rounded				Low.
Frosthechno		½ longer than wide			In front	Behind	Middle		Rounded	Convex			
Sobara	Moderately high	Longer than wide			In front				Rounded				Less than ½.
Ergane	High	Longer than wide			Both				Round d				½.
Scea	High	Longer than wide							Rounded				½.
Lagasca	High	Little longer than wide								Plane			As wide.
Opisthoncus	High	L nger than wide			In front			Roun ed		Convex	Inclined		Less than ½.
Bootes		½ longer than wide	Little wider		Behind				Rounded	Convex	Inclined		
Mago	High behind												Low.
Oecipus								Vertical	Rounded	Convex			Very low.
Scartes									Truncated	Convex	Inclined		More than ½.
Janigena									Slanting	Convex	Inclined		Less than middle eyes.
Mithion		Very long							Slanting				
Lystrocteisa						Almost parallel							
Chalcolecta										Cephalic part almost plane	Not inclined	At least ½ longer	Scarcely ½.
Lyssomanes													
Jeskia		Long											
Epeus		Moderately long					Behind middle			Cephalic part plane	Inclined	Scarcely longer than cephalic	Almost ½.
Athamas		Short quadrate						Almost vertical	Almost vertical	Very convex			

TABLE II.

ANALYSIS OF GENERA OF THE FAMILY ATTIDÆ—Continued.

	Eyes in 3 or in 4 rows.	Quadrangle of Eyes.					First Row of Eyes.			Second Row of Eyes.		Third Row of Eyes.		
		As long or longer than wide.	How much wider than long.	Wider in front, or behind.	Width equal in front and behind.	Occupying what proportion of Cephalothrax.	In a curved or in a straight line.	Middle eyes touching or separated.	Lateral eyes touching or separated.	Nearer to anterior or posterior eyes.	Halfway between anterior and posterior eyes.	Size compared with lateral eyes.	Further from each other or from lateral borders.	Equally distant from each other and lateral borders.
Sandalodes	3		Wider		Equal	½	Curved	Separated	Separated		Halfway		Each other	
Icius	3		½ wider	Behind			Straight	Touching	Touching or separated			Smaller or equal	Each other	
Marpissa	3		At least ½	Behind			Straight or curved	Separated	Separated			Smaller or equal	Each other	
Epiblemum	3									Posterior				
Fulhonia	3		At least ½	Behind			Curved	Separated	Separated			Smaller		Usually.
Ballus	3			Behind			Straight or curved	Sub-touching	Sub-touching			Equal		
Sinaetha	3		Much	Behind			Curved	Separated	Widely separated	Anterior			Each other sometimes	Sometimes.
Dendryphantes	3			Little behind			Curved	Separated	Separated			Smaller	Each other	
Attus	3		Scarcely ½	Sometimes behind	Sometimes		Straight or curved	Near together	Separated			Usually smaller	Each other sometimes	Sometimes.
Pellenes	3		½	Behind			Straight or curved	Little separated	Separated			Smaller	Each other	
Menemerus	3		½ or ¼		Equal		Straight or curved	Little separated	Separated			Smaller or equal	Each other sometimes	Sometimes.
Hasarius	3		At least ½	Little behind			Little curved	Little separated	Separated			Smaller or equal	Each other	
Boethus	3		A little	In front		Between ⅓ and ½	Little curved	Sub-touching			Almost	Smaller	Lateral borders	
Eluribus	3		At least ½	Behind			Much curved	Separated	Separated			Smaller	Sometimes lat'l borders	Sometimes.
Ylienus	3		At least ½	Behind			Much curved	Separated	Separated			Smaller	Each other	
Mievia	3		Scarcely ½		Equal		Straight or curved	Touching	Separated			Equal	Lateral borders	
Viciria	3			Little in front	Equal	Not ⅓	Little curved		Widely separated		Sometimes		Lateral borders	
Bavia	3	As long as wide			Equal		Straight	Separated	Separated			Equal		
Euophrys	3		½		Equal		Straight or curved					Smaller or equal	Each other	
Eris	3			Much behind			Curved		Widely separated			Scarcely smaller		
Neon	3				Equal		Straight	Touching	Touching			At least as large		
Homalattus	3	As long as wide					Curved	Separated	Separated	Anterior				
Habronestum	3		Scarcely ½		Equal		Straight or curved	Separated	Separated			Smaller		Equally.
Heliophanus	3		½ or ⅔		Equal		Straight or curved					Smaller		
Hyctia	3	As long as wide			Equal		Straight	Touching				Smaller	Each other	
Cyrba	3		Almost ½		Equal		Straight	Separated	Separated			Scarcely smaller	Each other	
Phidrga	3		½	Sometimes behind	Sometimes		Curved	Near together	Separated			Smaller	Each other	
Saitis	3		½	Little in front			Straight	Separated	Separated			Smaller	Each other	
Neretha	3			Behind			Straight	Separated	Separated			Smaller		
Thyene	3		At least ½	Much behind			Curved	Separated	Widely separated			Smaller	Each other	
Plexippus	3	Longer than wide		Little behind		Not ½	Curved		Separated	Anterior		Smaller	Each other	
Zenodorus	3		About ½		Nearly	Usually ½	Curved		Separated		Almost		Lateral borders	
Eurvattus	3		About twice as wide	Little behind			Usually curved	Much separated	Much separated	Anterior			Sometimes each other	Sometimes.
Philippus	3						Curved	Near together	Separated	Anterior		Smaller		
Cocalus	3						Straight	Near together	Near together			Equal		Equally.
Linus	3		A little	Little in front		About ⅓	Curved		Separated		Halfway		Lateral borders	
Hyllus	3		Wider		Equal	Not ½	Curved		Separated	Anterior			Each other	
Ciris	3						Straight							
Amycus	3						Curved			Sometimes anterior	Sometimes halfway	Equal		
Thyrde	3		But little		Equal		Curved	Separated			Halfway	Smaller		
Thiania	3									Posterior		Smaller		
Chirothecia	3						Straight			Anterior		Smaller		
Direocnemius	3	As wide behind as long				About ⅓					Halfway			
Diolenius	3													
Ascyltus	3		Wider											
Mopsus	3						Curved	Touching	Touching	Posterior				
Coccorchestes	3		Wider				Curved	Sub-touching	Sub-touching					
Omoedus	3		Much		Almost	Not ½	Usually curved				Halfway		Each other	
Rhomburcus	3	Longer than wide		Behind		More than ½	Curved	Close together	Close together	Anterior			Each other	
Dunoetus	3	Longer than wide		Behind			Curved	Close together	Close together	Anterior			Each other	
Synemosyna	3									Anterior				
Leptorchestes	3	Longer than wide					Straight	Touching	Touching			Smaller or equal		
Synageles	3	Longer than wide				More than ½	Straight	Touching	Touching			Equal		
Agorius	3	About as long as wide	A little	Sometimes in front	Sometimes	Almost ½	Curved	Touching	Separated	Anterior			Each other	
Sailicus	3		Wider	Behind	Equal	Not ½	Straight	Sub-touching	Sub-touching			Equal		
Sehophora	3		Wider	Behind		Not ½	Nearly straight	Separated	Separated	Posterior			Each other	
Hypoblemum	3		Wider	In front		Not ½	Curved		Separated		Halfway		Each other	
Ioua	3		Wider	In front		More than ½	Curved	Close together	Close together		Halfway			Equally.
Therosa	3		Wider	In front		Not ½	Curved	Close together	Close together		Halfway		Each other	
Cytaea	3		Wider	Sometimes in front	Sometimes	Not ½	Curved				Halfway		Each other	
Tara	3		Wider		Equal	Not ½	Curved	Close together	Close together	Anterior			Each other	
Lauharulla	3		Wider	In front		Not ½	Curved			Anterior		Smaller	Each other	
Pirithous	3		Wider	Behind		Not ½	Curved		Widely separated	Anterior			Each other	
Sinamoea	3		Wider	In front		Not ½	Curved	Close together	Close together		Halfway		Lateral borders	
Dimor	3		Wider behind	Behind		Not ½	Curved		Separated	Anterior			Each other	
Astia	3		Wider	In front						Anterior			Sometimes each other	Sometimes.
Johus	3		Wider		Equal	Not ½	Curved	Close together	Close together		Halfway		Lateral borders	
Margaromma	3		Wider	In front			Curved	Close together	Close together	Posterior			Lateral borders	
Prosthechina	3		Scarcely	In front		Not ½	Little curved	Close together	Close together		Halfway		Each other	
Sobara	3		Wider	Behind		Not ½	Curved	Separated	Separated		Halfway		Each other	
Ergane	3		Wider		Equal	Not ½	Curved				Halfway			Almost.
Scaea	3		Wider		Equal	Not ½					Halfway		Lateral borders	
Lagnus	3		Wider in front	In front		Not ½	Curved	Close together	Close together		Halfway		Lateral borders	
Onathemus	3		Wider	Sometimes behind	Sometimes		Curved		Separated	Anterior			Each other	
Bootes	3		Wider		Equal	Almost ½	Curved		Separated		Halfway		Each other	
Mogo	3		Little wider		Equal		Straight				Halfway	Smaller		
Oenipus	3			Behind			Curved			Anterior				
Scartes	3						Curved		Separated					
Jamtgena	3			Behind										
Mithion	3	As long as wide		Sometimes behind	Sometimes		Straight	Touching				Equal	Each other	
Lystrectoica	3	Much longer than wide		Behind		More than ½				Anterior		Larger		
Chinlocleria	3					At least ½	Little curved							
Lyssomanes	4			In front	About equal			Separated	Separated					
Jelskia	4			In front			Separated	Separated	Separated					
Epeus	4						Little separated	Separated	Separated			Equal		
Athamas	4													

TABI

ERA OF TH

	ABDOMEN.
Lengt	Shape.
onger than lip	Twice as long as wide
	Short
	Oval and flat
ore than twice	Long and flattened

TABLE III.

ANALYSIS OF GENERA OF THE FAMILY ATTIDÆ—Continued.

	Sternum.			Coxae.			Maxillae.		Lip.		Abdomen.
	Length.	Width.	Shape.	1st pair separated by width of lip or by less.	Which pair thickest.	Which pair longest.	Length.	Shape.	Length.	Shape.	Shape.
Sandalodes	Long	Narrow					½ longer than lip				
Icius			Contracted in front						Longer than wide		Twice as long as wide
Marpissa	Twice as long as wide	Narrow		By much less							
Euophrys	Long										
Phidacus		Rather narrow		By width		IV		Pointed, parallel, wide at base			
Bathus		Wider than 2nd and 3d coxae									
Simatha		As wide as the 1st coxae	Attenuated at both ends	By less					Conical		
Dendryphantes	Long	Rather narrow		By width	I						
Attus	Long										Short
Pellenes	Long			By width	I	I					
Menemerus	Almost twice as long as wide			By width	I	I					
Hasarius	Long	Rather narrow	Contracted in front	By width	I	I					
Boethus		Much wider than coxae		By width	I	I					
Eluthus	Long	Very narrow									Oval and flat
Ylleous	Short	Narrower than 2d and 3d coxae		About the width		I	More than twice as long as lip	Narrow			
Maevia				By less	I	IV			About as long as wide	Widely truncated at tip	Long and flattened
Viciria	Rather short	Wider than coxae									
Bavia	Rather short	About width of 2d and 3d coxae		At least by width			Long				
Euophrys		Often wider than 2d and 3d coxae	Oval	By width at least	I	I			Nearly ½ longer than wide	Narrower and rounded at tip	Long, slender
Eris	Short	As narrow as 2d and 3d coxae		By width					Twice as long as wide		
Neon		Wider than 2d and 3d coxae	Triangular	Often by less		IV					
Dendrattus											
Habrocestum	Long	Narrower than 2d and 3d coxae		By less							
Hebophanus		Wider than 2nd and 3d coxae		By width							
Hyctia	Twice as long as wide	Narrow		1st coxae touching	I	I		very wide with projections			Broad as long
Cyrba		Wider than 2d and 3d coxae	Small	At least by width		IV					
Phlegra	Twice as long as wide	As wide as 2d and 3d coxae	Oval	By width		IV					Narrow, long
Saitis		Moderately wide	Contracted in front	By width		IV					
Neotha		As wide as 2d and 3d coxae	Contracted in front	Oval							
Thyene	Long		Oval								
Plexippus		Wider than 2d coxae	Contracted in front	By width and II	I						
Zenodorus	Rather short	Wider than coxae									
Eryaxius		Wider than coxae					At least ½ longer than lip	Parallel, sub-ovate	Not longer than wide		
Phidippus								Parallel, sub-ovate			
Coccilus									Longer than wide	Truncated	Sub-ovate
Linus											Sub-ovate
Hyllus	½ longer than wide										
Cira			Moderately convex				Almost twice as long as lip	Narrow at base, sub-ovate	A little longer than wide		Cylindrical
Amyeus								Rounded at tip	More than ½ as long as maxillae	Narrowing at tip	Sub-ovate
Phyale											
Thiania											Almost circular
Chirothecia											Narrow, oblong-oval
Dioscocnemius											
Diolenius		Not narrower than coxae									
Asceltus							About twice as long as wide	About as wide as length of lip	Longer than wide	Sub-truncated	Long
Mogrus											
Corticolates											Long, narrow
Omoedus		Wider than coxae									
Rhenobotus	Long	Wider than coxae					Short	Narrow at base, wide at tip	Longer than wide	Rounded at tip	Truncated in front, high, short
Damoetas	Long	Narrow		Widely separated			Long	Narrow at base, sub-ovate	Scarcely or not wider than long	Rounded at tip	Short, truncated in front
Synemosyna		Narrow						Convex, tip rounded	Half as long as maxillae	Rounded at tip	Cylindrical, constricted
Leptorchestes								Convex, tip rounded	Scarcely ½ as long as maxillae	Rounded at tip	Long, constricted
Synageles								Tip truncated	Short	Rounded at tip	Long, constricted
Agorius		As narrow as 2d and 3d coxae							About twice as long as wide. Parallel	Obtuse at tip	
Salticus		Wider in middle than 2d and 3d coxae	Oval						As wide as long	Semi-circular	
Sebastira		Much wider than coxae							A little wider than long		
Hypobletum		Very narrow		Widely separated			Rather short	Very wide, square at tip	Much longer than wide	Truncated	Slender, sub-cylindrical
Ione	½ longer than wide	Wider behind					Twice as long as lip	Sub-ovate rounded	Not longer than wide	Narrowing at tip	
Thorina	½ longer than wide		Convex				Long	Tip truncated	A little longer than wide	Narrowing at tip	Long
Cytaea	Twice as long as wide	Contracted in front	Oval				Twice as long as lip		as long as maxillae	Narrowing at tip	Twice as long as wide
Tara	Longer than wide							Dilated, rounded at tip	as long as maxillae	Rounded at tip	Long, ovate
Lauharulla	Longer than wide		Oval						Not more than ½ as long as maxillae	Rounded at tip	Long, narrow
Pirithous	Longer than wide		Plane					Dilated, rounded at tip			
Simaetha	Longer than wide		Heart-shaped					Dilated, rounded at tip			
Bianor	Longer than wide		Small				More than twice as long as lip	Dilated at tip	Wider than long	Rounded at tip	Long
Astia	Twice as long as wide		Rounded plane				Long	Dilated at tip	Longer than wide		Short
Jotus								Dilated, rounded at tip	Longer than wide		Oval
Marpissa	Much longer than wide		Ovate cordate				Not twice as long as lip	Dilated and rounded at tip	Not longer than wide		Long, narrow
Prostheclina	Longer than wide		Ovate convex				Twice as long as lip	Dilated and rounded at tip			Longer than wide
Sobara			Convex								Ovate, truncated in front
Ergane			Oval convex				Rather long	Dilated and rounded at tip	More than ½ as long as maxillae		Rounded in front, pointed behind
Scaea			Plane rounded				Rather long	Dilated and rounded at tip	Not more than ½ as long as maxillae	Narrowing at tip	Short, ovate
Lagnus	Short		Ovate cordate					Dilated and rounded at tip	as long as maxillae	Narrowing at tip	Ovate
Opisthoncus	Long	Narrow	Plane				Not twice as long as lip	Wide at tip	More than 1 as long as maxillae	Narrowing and truncated at tip	Long, narrow
Bootes								Dilated in front			Ovate
Mago			Oval convex				Not twice as long as lip				Broad, ovate
Oedipus			Nearly round				Long	Tip dilated ant. and lat. margins form an angle	More than ½ as long as maxillae	Convex, narrowing and rounded at tip	Long
Scartes								Dilated and rounded at tip	More than ½ as long as maxillae	Contracted and truncated at tip	
Janigena							Long	Dilated and rounded at tip	Length of maxilla not longer than wide	Rounded at tip	Lavel
Mithion	Long	In middle equal to intermediate coxae	Oval. Narrowing at ends	By width	I				About ½ as long as maxillae	Contracted and rounded at tip	Small, convex in front
Lystrocteisa											Oval
Chalcolecta											
Lyssomanes											
Jelskia											
Epeus							Short	Parallel, rounded			
Athamas		Scarce wider than coxae 2d and 3d	Convex	At least by the width						Conical, truncated	Cylindrical, long, slender
							Rather short	Dilated and rounded at tip	Short	Small, a somewhat curvilinear	Small, short, oval

TABLE IV

ANALYSIS OF GENERA OF THE FAMILY [illegible]

Genus	Fa[illegible]: Vertical, inclined or horizontal	Vertical, inclined or horizontal	Diverging or not diverging	Robust or weak	Length	Relat[illegible] length of legs	Relative [illegible] of legs	Which legs [illegible] most robust	Length of tibia and patella of 1st pair compared with [illegible]	Length of [illegible] 1st [illegible] compared with patella [illegible]	[illegible] tarsus + tarsus [illegible] compared with tib + pat [illegible]	Length of tib + pat of [illegible] compared with [illegible] + pat of [illegible]	Length of metatarsus + tarsus of 4th compared with tib + pat of 4th	Spines on metatarsus of 4th to base or only at apex
[illegible]	Vertical	Vertical	Not diverging		Short	1123	142	I						
[illegible]	Inclined forward	Vertical		Rather robust	Short [illegible] longer	1432	4132	I	Shorter	Longer		Shorter	Shorter	To base
[illegible]						1234	1234	I	Shorter	Longer or equal		Much shorter	[illegible]	Only at apex
[illegible]	Horizontal	Vertical		Slender	[illegible]	4123	4123						Shorter	
[illegible]	Often inclined			Robust	Longer than [illegible]	1243	4132	I and II	Shorter	Longer [illegible] equal				
[illegible]					Short	4132	4132	I				Much shorter	Shorter or equal	To base
[illegible]							1423	I				Much shorter	Often shorter	No spines
[illegible]	Vertical	Vertical		Robust		1243 or 4123	4123 or 4132	I or I and II	Shorter	[illegible]		Much shorter	Shorter	Only at apex
[illegible]	Vertical	Vertical		Weak	Not longer than face	4123 or 1423	4123 or 1423		Almost as short	[illegible]		Much shorter	Often shorter	To base
[illegible]	Vertical or inclined	Vertical or inclined			Not longer than face	1342	3142	I	Shorter	[illegible]	Shorter	Longer	Often longer	To base
[illegible]						1423 or 4123	[illegible]	I		Usually longer		Much shorter	Shorter	To base
[illegible]	Sub vertical	Sub vertical			At least as long as face	1342	3412	I and II	Shorter	Longer or equal		Longer [illegible]	[illegible]	To base
[illegible]						4123	4123	I				Shorter	Equal	To base
[illegible]	Inclined backward	Inclined backward		Not very robust	Shorter than face	3412, 4312 or 4312	3412, 4312 or 4312	I and II	Much shorter	Equal	[illegible]	Longer or equal		To base
[illegible]	Vertical	Vertical		Weak	Shorter than face	4312	4312	I and II	Much shorter	Equal	[illegible]	Much shorter	Much shorter	To base
[illegible]	Vertical		Diverging a little		Not much long'r than face	1432	1432	I and II	At least as long	Longer		Much shorter	Equal	To base
[illegible]	Inclined forward	Inclined forward				3rd or 1st longest	3rd or 1st longest	Sometimes I				Longer [illegible]		
[illegible]	Inclined forward	Inclined forward			Rather short	4123		I	As long	Much longer		Much shorter	[illegible]	To base
[illegible]	Vertical	Vertical			Shorter than face	4312 4132 or 1432	4312 4132 or 1432	I or I and II	Often shorter		Shorter	[illegible]	[illegible]	No spines
[illegible]	Vertical	Vertical		Robust	Short	1432 or 4132	1432 or 4132	I				[illegible]	[illegible]	
[illegible]	Inclined	Inclined		Slender	Short	4132	4132	I				Shorter	[illegible]	Only at apex
[illegible]												[illegible]	Shorter	No spines
[illegible]	Vertical or oblique	Vertical or oblique		Weak	About as long as face	3412	3412							
[illegible]	Vertical	Vertical		Rather robust		4123 or 4132	4123 or 4132		Shorter			Much shorter	[illegible]	
[illegible]	Inclined	Vertical		Robust	Longer than face	1423	1423	I	At least as long	Longer	Shorter			
[illegible]	Vertical	Vertical		Not robust	As long as face	4132	4132	I	Shorter	Longer	Shorter	Much shorter	[illegible] equal	
[illegible]	Vertical or inclined	Vertical or inclined			Shorter than face	4132 or 4312	4132 or 4312		½ shorter	Equal	Shorter	Much shorter	Longer	To base
[illegible]	Inclined	Inclined		Slender	Shorter than face	3412	3412		½ shorter	Almost equal	Equal	[illegible]		To base
[illegible]	Vertical	Vertical			Not long	3412 or 1342	3412 or 1342	I				Longer	Shorter or equal	Only at apex
[illegible]	Vertical	Vertical		Robust	Short	1342	1342	I	As long [illegible] shorter	Longer [illegible] equal		Longer [illegible]	[illegible]	To base
[illegible]	Vertical	Vertical	Not diverging	Robust	Rather long							Shorter	[illegible]	To base
[illegible]	Vertical	Vertical				1st or 2d longest	1st or 3d longest					Longer		
[illegible]	Nearly vertical	Nearly vertical				1342	1342					Longer		To base
[illegible]			Diverging	Robust		1423	1423							
[illegible]	Vertical	Vertical		Slender	Long	1423	1423							
[illegible]	Not extended	Not extended			Short	1423	1423							
[illegible]			Diverging	Robust	Long	1243	1423							To base
[illegible]	Vertical	Vertical		Robust	Not long	Short, nearly equal	Short nearly equal					[illegible]		To base
[illegible]					Very long	1324 or 3124	1324 or 3124							
[illegible]						1342 or 3412	1342 or 3412	I and II						
[illegible]					[illegible] rather short									
[illegible]	Horizontal	Almost vertical			[illegible] short [illegible] long			I						
[illegible]						4123	[illegible]	I						
[illegible]	Almost vertical	Almost vertical	Diverging		[illegible] longer than [illegible]	1st and second longest	1st and second longest	I and II						
[illegible]	Almost vertical	Almost vertical												
[illegible]	Sub vertical	Sub vertical			Short	1423 or 4132	1423 or 4132							
[illegible]	Sub vertical	Sub vertical			Short		[illegible]							
[illegible]						[illegible]	[illegible]	I				[illegible]	[illegible]	
[illegible]						[illegible]	[illegible]	I				[illegible]	[illegible]	
[illegible]					Short	4th longest	4th longest							
[illegible]	Vertical	Vertical		Robust	Short	[illegible]	[illegible]					Much shorter	Shorter	[illegible]
[illegible]	Vertical	Vertical		Robust	Short	[illegible]	[illegible]					Much shorter	Shorter	[illegible]
[illegible]		Vertical		Weak		4132	[illegible]							
[illegible]	Horizontal	Vertical		[illegible] robust	[illegible] short [illegible] long	[illegible]	[illegible]			Much longer		[illegible]		
[illegible]			Not diverging		Short	[illegible]	[illegible]					[illegible]		
[illegible]					Short	[illegible]	4321					[illegible]		
[illegible]			Not diverging		Short	[illegible]	[illegible]					[illegible]		
[illegible]			Not diverging		Short	1432	1432	[illegible]				[illegible]	[illegible]	
[illegible]			Not diverging		Short	4312 or [illegible]	4312 or [illegible]	I				[illegible]	[illegible]	
[illegible]			Not diverging		Short	[illegible]	[illegible]					[illegible]	[illegible]	
[illegible]	Vertical	Vertical	Not diverging		Short	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	
[illegible]			Diverging			[illegible] or 1243	[illegible]	I				[illegible]	[illegible]	
[illegible]			Not diverging		Short	[illegible]	[illegible]					[illegible]		
[illegible]	Vertical	Vertical	Not diverging			[illegible]	[illegible]	I				[illegible]	[illegible]	
[illegible]			Not diverging		[illegible]	4312 [illegible]	[illegible]	I				[illegible]	[illegible]	
[illegible]			Not diverging		Short			[illegible]				[illegible]	[illegible]	
[illegible]			Not diverging		[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	
[illegible]			Not diverging	Slender	Rather long	[illegible]	[illegible]					[illegible]	[illegible]	
[illegible]			Not diverging		[illegible]	[illegible]	[illegible]	I				[illegible]		
[illegible]						[illegible]	[illegible]	I				[illegible]		
[illegible]						[illegible]		I				[illegible]		
[illegible]			Not diverging		[illegible]	[illegible]	[illegible]	I [illegible]				[illegible]		
[illegible]	Inclined forward	Inclined forward	Diverging	[illegible]		[illegible]	[illegible]	I						
[illegible]						[illegible]	[illegible]							
[illegible]						[illegible]	[illegible]							
[illegible]					Very short				[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		Vertical												
[illegible]				[illegible]		[illegible]	[illegible]							
[illegible]	Vertical	Vertical		Slender		[illegible]	[illegible]							
[illegible]	Vertical	Vertical				[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]						[illegible]	[illegible]							

TRANSACTIONS

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ATTIDÆ OF NORTH AMERICA.

BY

GEORGE W. AND ELIZABETH G. PECKHAM.

INTRODUCTION.

On account of the habits of the Attidæ they are, in comparison with other families, poorly represented in collections. The most important contribution to the knowledge of North American species is the work of N. M. Hentz, his studies having been largely carried on in the southern states. The papers of Hentz were originally published in the Journal of the Boston Society of Natural History, from 1842-45, but are found in more convenient form in the collection made by Burgess in 1875. The works of Baron Walckenaer, 1837-47, and that part of Die Arachniden, by C. Koch, published in 1846, contain discriptions of many American Attidæ, but owing to the vagueness of the descriptions comparatively few can be identified with certainty. So far as Koch is concerned this is of slight importance, as his work was preceeded by that of Hentz. But with Walckenaer the question of priority comes up, as doubtless many of the species commonly ascribed to Hentz were first published by him, and he should be credited with all such species as can be identified from his descriptions. The important question is, what species can be identified by Walckenaer's descriptions?

We have made a very careful study of the descriptions of Walckenaer's sixty-four species, comparing them with nearly all Hentz's species and with many others from different sources and we have been able to identify only four.

On the subject of priority we agree with Dr. Thorell that "to reject a name, as some have proposed to do, on account of *defectiveness* in the definition, would seem not to be right, as leaving room for much arbitrariness. What seems to one good enough may to another appear insufficient or faulty. *When one only knows with certainty what is to be understood by such a name*, every one can either alter or improve the characterization for himself.[1]" We wish it to be understood that we reject none of Walckenaer's species on account of defectiveness of definition. We accept them whenever we are able to identify them.

Walckenaer's work on North American species was largely based on the manuscript plates of Abbot. He does not, so far as we know, state expressly that he has seen any of the specimens, but that he has examined most of them must be understood from the following statement which he makes before enumerating thirteen species. "Les espéces suivantes n'out pas été observées par nous, et ne sont placeés dans cette section que sur les indications fournies par les figures de l'ovurage MSS. d'Abbot, intitulé: Georgian Spiders."

[1] On European Spiders, I., p. 5. The italics in the concluding sentence are ours.

Had Walckenaer published Abbot's plates in connection with his descriptions it would doubtless have been easy to identify many of his species, but as the law of priority deals only with published matter, his claim to species must rest upon his descriptions alone, although Abbot's manuscript plates may be seen in the British Museum. In the event of their publication at some future time, such species as are identifiable, for the first time, through the figures, must be ascribed to Abbot at that date, and not to Walckenaer.

A good example of the difficulties of dealing with Walckenaer may be found in a species which he published in his first volume as *Attus protervus*, a black spider with black legs and palpi. In his fourth volume he refers to this species, saying: "Add to the synonymy *Plexippus undatus* Koch." Now there is no doubt that this last mentioned spider is identical with *Attus vittatus* (♂) Hentz, one of our most common species. The description and figure of Koch represent it fairly well as a dark spider with chevrons of white hair, and *yellow legs and palpi*. As a matter of fact the general appearance is very seldom so dark as would appear from Koch, who seems to have described from a single specimen. If, indeed, Walckenaer's *A. protervus* and Koch's *Pl. undatus* are identical, Walckenaer's description is absolutely false and bears no resemblance to the species. We can only suppose that Walckenaer was mistaken in thinking them identical.

We have collections from various parts of North America. Those of Count Keyserling (containing a number of type-specimens) and of Mr. Nicolas G. Pike have been of especial use to us. We are also indebted for specimens to the following persons. The locality in which each collection was made is indicated after the name of the sender.

Miss Edith Gifford, Mexico; Mr. Chas. Mann, Louisiana, Florida; Mr. Fr. Rauterberg, Texas; Miss Augusta Tovell, Texas; Mr. Thos. Gentry, North Carolina, South Carolina, Georgia; Mr. F. S. Risley, Florida; Col. J. J. Young, Pennsylvania; Mr. Philip Nell (for many specimens), Pennsylvania; Mrs. Mary B. Putnam, Iowa, Utah; Mr. Aurelius Todd, Oregon; Miss Murray, California; Mr. L. E. Ricksecker, California; Prof. J. J. Rivers, California; Mr. W. G. Harford, California, Washington Territory; Mr. W. G. Wright, California; Prof. O. B. Johnson, Washington Territory; Dr. F. Brendel, Illinois; Mr. Philip Abbot, Massachusetts; Mr. H. Van Rensselaer, Connecticut; J. B. Tyrrell, Esq. (Geol. Survey of Canada), Canada, Rocky Mountains; Rev. H. C. McCook, various parts of United States; M. E. Simon, Mexico; Dr. Ferdinand Karsch, collection of Attidæ of Royal Museum of Berlin (containing many North American specimens.)

North American Attidæ have been described by the following writers:

Walckenaer: Hist. Nat. des Insectes Aptères, 1837?–47.

N. M. Hentz: Occasional Papers, 1842–45.

C. Koch: Die Arachniden, 1846.

Giebel: Illinois Spiders, Zeitschrift fur Gesammten Naturwissenschaften, 1869.

J. Blackwall: Spiders from Canada, Ann. & Mag. of Nat. Hist.

T. Thorell: Spiders of Colorado, Bull. of Hayden's U. S. Survey of the Territories.

E. Keyserling: Neue Spinnen aus Amerika, VI.

H. C. McCook: Proc. Acad. Nat. Sci. of Philadelphia, 1883.

Peckham: Descr. new or little known Attidæ, 1883.

The Attidæ have usually a high cephalothorax with almost vertical sides, and short and thick extremities, although there are many exceptions. Perhaps the position and relative size of the eyes — in which they most nearly approach the Lycosidæ — is of most value in defining the family. The eyes are arranged in three or four transverse rows, three in the sub-family Attinæ and four in the sub-family Lyssomanæ. In the former the first row is composed of four eyes, the middle ones being the largest; the second row is composed of two very small eyes, and the third of two of medium size. In the Lyssomanae, the two outer eyes of the first row are placed so far back as to divide it into two transverse rows; otherwise the eyes are alike. The spiders are, many of them, very brilliantly colored — as much so as are the humming birds or beetles. As the markings are commonly formed of colored hairs or scales, they change considerably when the spider is wet, and are moreover, very easily rubbed off. The entire appearance of a spider may thus be changed, and its identification rendered difficult, if not impossible. The Attidæ, like the birds, moult frequently, and at each moult the markings may change, so that some of the older writers have formed several species for the different moults of one. These difficulties are increased by the fact that the adult males and females of a species usually differ considerably in appearance.

Although a great many species have been described, we have been able to identify but a limited number. The Attidæ live on the ground, on plants, and on trees, jumping on their prey. They form no web, but generally attach a line when they jump, to save themselve in case they miss their aim. The females place the cocoon under leaves or bark and spin some cross lines, under which they stand until the eggs are hatched.

Of the fifty-five species described by Hentz, we have identified forty-five. Of the ten remaining, probably five or six are varieties of those that we have described, but this being uncertain, we have not included them.

The key which follows is useful only in determining the species described in this paper:

Key to Genera of North American Attidæ.

1. Eyes in four rows ..... Lyssomanes.
2. Eyes in three rows 3
3. Body slender, ant-like, legs weak 5
4. Body not slender nor ant-like 9
5. Cephalic part higher than thoracic; lip much longer than wide ..... Salticus.
6. Cephalic part not higher than thoracic; lip as wide as long 7

7. Thoracic part divided by a marked constriction into a shorter anterior and a longer posterior portion; quadrangle of eyes wider than long.....SYNEMOSYNA.
8. Thoracic part not divided; quadrangle of eyes much longer than wide.....SYNAGELES.
9. Cephalic part at least as long as thoracic[1]..... 11
10. Cephalic part shorter than thoracic..... 21
11. Cephalic part occupying $\frac{2}{3}$ of the cephalothorax.....[2]HOMALATTUS.
12. Cephalic part occupying plainly less than $\frac{2}{3}$ of cephalothorax..... 13
13. Spiders very small — not so much as 3 mm. long..... 15
14. Spiders[3] not very small 17
15. Quadrangle of eyes equally wide in front and behind, legs 4, 3, 1, 2 [4]NEON.
16. Quadrangle of eyes wider behind, legs 4, 1, $\overline{2, 3}$.....BALLUS.
17. Quadrangle of eyes equally wide in front and behind; first row strongly curved; cephalothorax very convex, with cephalic part strongly inclined forward, and falling steeply behind...AGOBARDUS.
18. Quadrangle of eyes wider behind; first row straight or very slightly curved; shape of cephalothorax unlike the above..... 19
19. Cephalothorax high, nearly as wide as long; dorsal eyes at widest point of cephalothorax, opposite a corner, and projecting; quadrangle of eyes, looked at from above, seeming to occupy $\frac{4}{4}$ of cephalothorax.....ZYGOBALLUS.
20. Unlike the above.....ERIS.
21. Quadrangle of eyes wider in front..... 23
22. Quandrangle of eyes wider behind, or equally wide in front and behind..... 27
23. First row of eyes straight; patella + tibia III shorter than patella + tibia IV .....ASTIA.
24. First row of eyes curved; patella + tibia III equal to patella + tibia IV..... 25
25. Dorsal eyes nearer to each other than to lateral borders; legs (♂) 1, 3, 4, 2; (♀) 4, 3, 1, 2.....PROSTHECLINA.
26. Dorsal eyes further from each other than from lateral borders; legs (♂ ♀) $\overline{4, 3}$, $\overline{1, 2}$ .....[5]SAITIS.

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[1] The cephalic part extends from the anterior margin of the lateral eyes of the first row to the posterior margin of the eyes of the third row.

[2] The only North American species of this genus yet known has metallic reflections, and when the spider is looked at from above the cephalic part seems to occupy nearly the whole cephalothorax.

[3] *Zygoballus sexpunctatus* H. is only 3 mm. long, but is distinguished from *Neon* and *Ballus* by its peculiar falces, as well as by the shape, and greater height of its cephalothorax.

[4] In *Neon* the dorsal eye is plainly larger than the anterior lateral.

[5] In *Saitis* legs III and IV are much longer than I and II, while in *Prostheclina* the difference is not so marked.

27. [1] Cephatolthorax high, massive; quadrangle of eyes plainly wider (often much wider) behind; first row of eyes usually curved; legs 1, 4, 3, 2, 1, 4, 2, 3, 4, 1, 3, 2, or 4, 3, 1, 2..... 29
28. Unlike the above..... 33
29. Legs 1, 4, 3, 2, 1, 4, 2, 3 or 4, 1, 3, 2..... 31
30. Legs 4, 3, 1, 2.....PLEXIPPUS.
31. Eyes of second row twice as far from dorsal as from lateral eyes. PHIDIPPUS.
32. Eyes of second row halfway or about halfway between lateral and dorsal eyes.....PHILÆUS.
33. Third leg longest, fourth next.....HABROCESTUM.
34. Unlike above..... 35
35. Cephalothorax convex, and high, or moderately high..... 51
36. Cephalothorax low and flat..... 37
37. Abdomen at least four times as long as wide; cephalothorax low and flat, not wider than third row of eyes; legs of first pair very long.....HYCTIA.
38. Unlike the above..... 39
38. Spines only on metatarsi of first pair.....[2] ADMESTINA.
40. Legs all spined..... 41
41. Cephalothorax plainly wider than third row of eyes, quadrangle equally wide in front and behind..... 43
42. Unlike the above..... 45
43. Quadrangle of eyes $\frac{1}{4}$ wider than long, occupying $\frac{2}{5}$ of cephalothorax; lateral eyes of first row separated by not more than $\frac{1}{3}$ their own diameter from middle eyes.....MENEMERUS.
44. Quadrangle of eyes $\frac{1}{3}$ wider than long, occupying $\frac{1}{3}$ of cephalothorax; lateral eyes of first row separated by at least $\frac{1}{2}$ their own diameter from middle eyes.....MARPTUSA.
45. Middle eyes of first row three times as large as lateral eyes; quadrangle of eyes nearly twice as wide as long .....[3] SADALA.
46. Middle eyes of first row about twice as large as lateral eyes; quadrangle of eyes not more than $\frac{1}{3}$ wider than long..... 47
47. Metatarsi III and IV with spines only in terminal circles; legs never (♂) 4, 1, 2, 3, nor 1, 3, 2, 4; (♀) 4, 1, 3, 2, nor 4, 3, 1, 2.....ICIUS.
48. Metatarsi III and IV with spines throughout their length; legs (♂) 4, 1, $\overline{2, 3}$ or 1, 3, 2, 4; (♀) 4, 1, 3, 2 or 4, 3, 1, 2..... 49
49. Coxae I nearly touching; legs (♂) 4, 1, $\overline{2, 3}$; (♀) 4, 1, 3, 2; quadran-

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[1] Spiders in this group except *Phidippus rufus*, *Philæus militaris*, and *Plexippus puerperus* are large, from 8 to 16 mm (commonly about 10 mm) in length. The sides of the cephalic part are usually much swollen.

[2] Our only species of *Admestina* is small, not more than 4 m m long.

[3] *Sadala* is distingulshed from *Icius* by having spines throughout the length of the metatarsi of the third and fourth legs, and by having the leg formula 1, 4, 2, 3. Our only species of *Sadala* is from Mexico.

gle of eyes ½ wider than long; middle anterior eyes touching: eyes of second row a little nearer the lateral than the dorsal eyes, CYRBA.

50. Coxae I separated by width of labium; legs (♂) 1, 3, 2, 4: (♀) 4, 3, 1, 2; quadrangle of eyes less than one third wider than long; middle anterior eyes subtouching; eyes of second row halfway between lateral and dorsal eyes.....CYTÆA.
51. First row of eyes straight[1] 35
52. First row of eyes curved 59
53. Middle eyes of first row touching..... 55
54. Middle eyes of first row not quite touching 57
55. Metatarsi III and IV with spines only in terminal circles; quadrangle of eyes equally wide in front and behind; eyes of second row half way between lateral and dorsal eyes.....EPIBLEMUM.
56. Metatarsi III and IV spined throughout their length; quadrangle of eyes wider behind; eyes of second row nearer the lateral than the dorsal eyes.....ATTUS E. S.
57. Lateral eyes of first row nearly touching middle eyes; eyes of second row nearer lateral than dorsal eyes; legs (♂) 1, 4, 2, 3; (♀) 4, 1, 3, 2.....PSEUDICIUS.[2]
58. Lateral eyes of first row separated by ½ their own diameter from middle eyes; eyes of second row not nearer lateral than dorsal eyes; legs (♂) 1, 3, 4, 2; (♀) 4, 3, 1, 2 .....HASARIUS.
59. Dorsal eyes nearer to each other than to lateral borders.....MÆVIA.
60. Dorsal eyes further from each other than from lateral borders.... 61
61. Quadrangle equally wide in front and behind; legs 4, 3, 2, 1..... ATTUS W.[3]
62. Quadrangle wider behind; legs not 4, 3, 2, 1.....DENDRYPHANTES.

The following tables are useful only for spiders described in this paper. They are designed to furnish an easy method for determining species. To use them, determine the relative length of the legs of the spider in question and find the corresponding formula in the tables. This will usually place the spider in a group of four or five genera, rendering it a comparatively easy matter to determine the genus. When the difference between two legs is extremely slight they are placed together with a dash above. The tables do not include the genera *Synemosyna*, *Synageles*, *Salticus* and *Lyssomanes; Dendryphantes multicolor* also does not appear since our only specimen has but three legs.

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[1] It requires practice to distinguish a straight from a slightly curved row of eyes, but since these genera are only represented by three species the difficulty will be inconsiderable. *E. scenicum* is a dark spider with two oblique white bands on each side of the abdomen; *A. palustris* has two white spots near the center of the dorsum of the abdomen; *A. imperialis* has four snowy white oblique bands on the face and falces and a ring of white on the distal end of the femur of the palpus.

[2] Our only species of this genus is from west of the Rocky Mountains.

[3] The species which we leave in *Attus Walck.* It being only represented by an immature specimen we do not determine its genus.

TABLE OF LEG FORMULÆ FOR MALES.

1 $\overline{2\ 3\ 4}$

Plexippus puerperus.

1 3 $\overline{2\ 4}$

Cytæa minuta.

1 4 2 3

Phidippus mexicanus.
Phidippus arizonensis.
Phidippus insolens.
Phidippus johnsonii.
Phidippus octopunctatus.
Philæus chrysis.
Dendryphantes capitatus.
Dendryphantes flavipedes.
Attus palustris.
Attus imperialis.
Icius albovittatus.
Icius palmarum.
Hyctia pikei.
Marptusa familiaris.
Marptusa californica.
Menemerus melanagnathus.
Homalattus cyaneus.
Zygoballus sexpunctatus.
Zygoballus bettini.
Sadala distincta.

1 4 3 2

Icius piraticus.
Icius mitratus.
Menemerus paykullii.
Agobardus anormalis.

4 1 $\overline{2\ 3}$

Cyrba tæniola.
Ballus youngii.

$\overline{4\ 3}$ $\overline{1\ 2}$

Saitis pulex.

1 3 4 2

Hasarius hoyi.
Prostheclina cambridgii.

1 4 $\overline{2\ 3}$

Phidippus rufus.
Phidippus morsitans.
Phidippus cardinalis.
Philæus militaris.
Dendryphantes elegans.
Mævia californica.
Epiblemum scenicum.

$\overline{1\ 4}$ $\overline{2\ 3}$

Pseudicius harfordii.

$\overline{1\ 4}$ 3 2

Astia morosa.

3 4 1 2

Habrocestum coronatum.
Habrocestum viridipes.
Habrocestum peregrinum.
Habrocestum auratum.
Habrocestum hirsutum.
Habrocestum splendens.
Habrocestum oregonense.

4 1 3 2

Astia vittata.
Admestina wheelerii.

4 3 1 2

Plexippus putnamii.
Neon nellii.

4 3 $\overline{2\ 1}$

Attus cautus.

TABLE OF LEG FORMULÆ FOR FEMALES.

1 4 2 3

ERIS octavus.
ERIS nervosus.
HYCTIA pikei.

1 4 3 2

DENDRYPHANTES flavus.

3 4 1 2

HABROCESTUM cœcatum.
HABROCESTUM viridipes.
HABROCESTUM cristatum.
HABROCESTUM auratum.
HABROCESTUM splendens.

$\overline{4}$ 1 2 3

ZYGOBALLUS bettini.

4 1 $\overline{2\ 3}$

PHIDIPPUS rauterbergii.
PHIDIPPUS miniatus.
PHILÆUS fartilis.
PHILÆUS militaris.
DENDRYPHANTES capitatus.
CYRBA tæniola.
MARPTUSA familiaris.
MARPTUSA californica.
BALLUS youngii.

4 3 1 2

HASARIUS hoyi.
PROSTHECLINA cambridgii.
ASTIA vittata.
CYTÆA minuta.
MENEMERUS melanognathus.
AGOBARDUS anormalis.

4 $\overline{3}$ $\overline{1}$ 2

ASTIA morosa.

$\overline{4\ 3}$ 1 2

PLEXIPPUS puerperus.

1 4 $\overline{3\ 2}$

PHILÆUS mexicanus.
ICIUS palmarum.

$\overline{1\ 4}$ $\overline{2\ 3}$

PSEUDICIUS harfordii.

4 1 2 3

PHIDIPPUS morsitans.
PHIDIPPUS galathea.
PHIDIPPUS m'cookii.
PHIDIPPUS opifex.
DENDRYPHANTES alboimmaculatus.
ATTUS palustris.
ICIUS lineatus.

$\overline{4\ 1}$ $\overline{3\ 2}$

ICIUS mitratus.

4 1 3 2

PHIDIPPUS rufus.
PHIDIPPUS obscurus.
PHIDIPPUS insolens.
PHIDIPPUS albomaculatus.
PHIDIPPUS johnsonii.
PHIDIPPUS otiosus.
PHILÆUS farneus.
PHILÆUS chrysis.
PHILÆUS princeps.
PHILÆUS rimator.
DENDRYPHANTES elegans.
ERIS barbipes.
EPILBEMUM scenicum.

$\overline{4\ 3}$ $\overline{1\ 2}$

SAITIS pulex.

PHIDIPPUS (C. Koch.)

Cephalothorax high and convex, contracted in front and behind, sides usually widely rounded, especially in ♂, cephalic part inclined forward, and separated from the thoracic by a depression; thoracic part slanting, at first gradually and then more steeply from the dorsal eyes. Quadrangle of eyes $\frac{1}{3}$ wider than long (excepting *arizonensis*, which is $\frac{1}{2}$ wider than long, and *opifex* which is $\frac{2}{3}$ wider than long), wider behind than in front; anterior eyes small, in a curved row, the middle not more than twice as large as the lateral, and but little separated; the lateral separated from them by from $\frac{1}{3}$ to $\frac{2}{3}$ their own diameter; eyes of second row twice as far from dorsal as from lateral eyes; eyes of third row about as large as lateral eyes, at least as far from each other as from the lateral borders. Third row of eyes narrower than the cephalothorax at that place. Clypeus from $\frac{1}{4}$ to $\frac{1}{2}$ as high as large middle eyes, vertical. Falces usually stout and nearly twice as long as face. Labium longer than wide, about $\frac{1}{2}$ as long as maxillae. Sternum deep set, projecting between the anterior coxæ which are separated by width of labium or a little less. Legs (♂) 1, 4, 2, 3; (♀) 4, 1, 2, 3, or 4, 1, 3, 2; first leg stoutest, with femur and tibia enlarged and compressed, stouter than patella, and much stouter than metatarsus and tarsus. Tibia and patella of the first usually a little shorter than cephalothorax; tibia and patella of the third shorter than tibia and patella of the fourth; tibia and patella of the fourth at least as long as metatarsus and tarsus of the fourth. Femoral, tibial, metatarsal and sometimes patellary spines on the four pairs; metatarsi of the fourth, spined throughout their length.

PHIDIPPUS MORSITANS Walckenaer.

Plate I, figures 1, 1 a. Plate II, figure 1.

Syn.: 1837. ? Attus *morsitans* Walck., Hist. Nat. des Insectes Aptères, I. p. 432.
1844. " *audax* Hentz, Journal Boston Soc. Nat. Hist., Vol. IV.
1845. " *tripunctatus* id., ibid., Vol. V.
1846. Phidippus *variegatus* C. K., Die Arachn., XIII, p. 125.
1846. " *purpurifer* id., ibid., XIII, p. 127.
1846. " *smaragdifer* id., ibid., XIII, p. 128.
1846. " *alchymista* id., ibid., XIII, p. 131.
1846. " *rufimanus* id., ibid., XIII, p. 132.
1846. " *lunulatus* id., ibid., XIII, p. 133.
1846. " *mundulus* id., ibid., XIII, p 137.

Syn.: 1847. Attus *morsitans* Walck., Hist. Nat. des Insectes Aptéres, IV, p. 419.

1875. Attus *audax* Hentz, Coll. Arachn. Writings ed. by Burgess, Boston, p. 50.

1875. " *tripunctatus* id., ibid., p. 58.

1883. " " Peckham, Descr. new or little known, Attidæ, p. 33.

♂. Total length 11 mm. Width of abdomen 4.3 mm.

Cephalothorax: length 5.3; width 5.1; height 2.8. Legs: 11, 9.1, 9.1, 10.7; patella and tibia of the first, 5.5; patella and tibia of the third, 3.2; patella and tibia of the fourth, 4; metatarsus and tarsus of the fourth, 4.

Lateral separated from middle eyes by $\frac{2}{3}$ their diameter. Clypeus $\frac{1}{3}$ as high as large as middle eyes. Maxillæ slightly diverging, wide at extremity, with a projection at the outer corner, inner margin slanting toward labium. Labium $\frac{1}{2}$ as long as maxillæ, contracted and rounded at tip. Sternum convex, oval. Anterior coxæ separated by width of labium.

♀. Total length 15 mm. Width of abdomen 5.6 mm.

Cephalothorax: length 5.5; width 4.4; height 2.2.

Legs 10.6, 9, 9, 12.1; patella and tibia of the first, 4.2; patella and tibia of the third, 2.4; patella and tibia of the fourth, 3.2; metatarsus and tarsus of the fourth, 3.2.

Relative length of legs 4, 1, 2, 3.

Coloration. ♂. ♀. Cephalothorax black, covered with short black and gray hairs, and having some long black hairs on the sides near the small median eyes; there are sometimes white bands on the sides. Clypeus covered with white hairs. Femur of palpus reddish, with a black band on inner side, three black spines, and some black and white hairs. The falces are bright iridescent green, with reddish fangs. The sternum and venter are black, the venter having two whitish longitudinal bands which approach each other, but terminate near the apex without meeting. The abdomen is black, with thick, short, black hairs, and some long white hairs; at the middle point is a large, more or less triangular, white spot; posterior to this are two smaller, somewhat oblique, white spots; lower down, and nearer the apex than these, but in a line with them, are two minute white dots. The spots are formed by scales, which, through the microscope, look like grains of rice. In some specimens there are two oblique white bands on each side, and a white band at the base. Immature specimens frequently have the spots orange-colored instead of white. The legs are black and hairy, barred with rufus in young specimens; on the inner side of the patella of the first leg is a brush of white hairs.

Habitat. United States.

Although the markings of this spider are similar to those of *P. miniatus*, it has no red hairs when adult, and is thus easily distinguished from that

species. It is possible that *morsitans* grows larger in the western than in the eastern states, as Emerton gives 8.6 mm. as the total length of the ♀. A period of from fourteen to fifteen days is required for the development of the eggs of this species.

PHIDIPPUS RUFUS HENTZ.

Plate I, figure 2 a. Plate II, figure 2.

Syn.: 1845. ATTUS *rufus* H., Journal Boston Soc. Nat. Hist., Vol. V.
1845. " *castaneus* id., ibid., Vol. V.
1846. PLEXIPPUS *rufus* C. K., Die Arach., XIII, p. 120.
1846. " bi-vittatus id., ibid., XIII, p. 120.
1875. ATTUS *rufus* H., Coll. Arachn. Writ., ed. by Burgess, Boston, p. 60.
1875. " *castaneus* id., ibid., p. 55.
1885. PHIDIPPUS *ruber* Keyserling, Neue Spinnen aus Amerika, VI, Verhandlungen Zoologisch—botanischen gesellschaft, p. 7.

♂. Total length 8.5 mm. Width of abdomen 3 mm.

Cephalothorax: length 4.1; width, 3.4; height 2.5.

Legs, 9.9, 7.3, 6.8, 9.2; patella and tibia of the first 4.2; patella and tibia of the third 2.4; patella and tibia of the fourth 3.4; metatarsus and tarsus of the fourth 3.

Lateral rather more than one-half as large as middle eyes, separated from these by two-thirds their own diameter. Clypeus one-fourth as high as middle eyes. Maxillæ nearly parallel, enlarged at extremity, with projection at outer corner, slanting within toward labium. Labium a little more than one-half as long as maxillæ, contracted at tip. Sternum oval, convex, nearly twice as long as wide. Anterior coxæ separated by width of labium. Legs without patellary spines.

♀. Total length 11.8 mm. Width of abdomen 4.8.

Cephalothorax: length 5; width 3.8; height 2.7.

Legs 9.4, 8.1, 8.4, 9.9; patella and tibia of the first 3.8; patella and tibia of the third 3; patella and tibia of the fourth 3.5; metatarsus and tarsus of the fourth 3.4.

Maxillæ rounded at extremity; labium two-thirds as long as maxillæ; relative length of legs 4, 1, 3, 2.

Coloration. ♂. The cephalothorax is covered with bright yellowish-red hairs, excepting the lower sides which are white; there are some long black hairs in the eye region. The face, clypeus and palpi are covered with white hairs; the falces are dark iridescent green; the mouth parts and coxæ are dark reddish brown; the sternum is black with white hairs; the venter is black, with two longitudinal lines of white hairs which converge behind. The abdomen is covered with

red hairs like those on the cephalothorax; it has a white basal band which extends on to the sides, and four indented dots. The legs are dark reddish brown, with many white hairs.

♀. The color is much less brilliant than in the ♂, being usually of a dull brick-red hue. The abdomen, besides the white basal band, has an oblique white band on each side, and two black bands on the posterior dorsal parts; these black bands reach the apex, and curve toward each other anteriorly; each has a white dot at its anterior, and one at its posterior end, and a transverse white line across the middle, where it is widest. The legs are reddish brown with black rings.

In *cardinalis*, with which it might be confused, the clypeus is one-third not one-fourth, and the lateral anterior eye is separated by one-half not two-thirds of its own diameter from the large middle eye. The second and third legs in *cardinalis* are about equal; in *rufus* the second is plainly longer than the third.

Habitat: United States.

PHIDIPPUS GALATHEA Walck.

Plate I, figures 3, 3a.

Syn.: 1837. Attus *galathea* Walck., Hist. Nat. des Insectes Aptères, I, p. 456.

1845. Attus *mystaceus* Hentz, Jour. Bost. Soc. of Nat Hist., Vol. V.

1846. Phidippus *asinarius* C. K., Die Arachniden, XIII, p. 139.

1847. Attus *galathea* Walck., Hist. Nat. des Insectes Aptères, IV, p. 422.

1875. Attus *mystaceus* Hentz. Coll. of Arachnological Writings, ed. by Burgess, p. 58.

♀ Total length 11.6 mm. Width of abdomen 4 mm.

Cephalothorax: length 5.2; width 3.8; height 2.

Legs 9.6, 8.5, 8, 10.6; patella and tibia of the first 4; patella and tibia of the third, 3; patella and tibia of the fourth, 3.9; metatarsus and tarsus of the fouth, 3.4.

Lateral separated from middle eyes by ⅔ their own diameter. Clypeus ⅓ as high as large middle eyes. Maxillæ widened and rounded at tip, nearly parallel. Labium ½ as long as maxillæ, about twice as long as wide, contracted toward tip. Sternum widest in the middle. Anterior coxæ separated by scarcely the width of the labium. Relative length of legs 4, 1, 2, 3.

Coloration: Cephalothorax black, covered with heavy gray hairs, and two tufts of black hairs on each side of the eye region. Abdomen covered with gray hairs with two pairs of white spots on the anterior part of the dorsum; when somewhat rubbed a blackish, scalloped band ap-

pears which occupies the central region. Clypeus covered with white hairs; palpi, legs, sternum, and venter with gray hairs; falces iridescent green; mouth parts reddish brown.

Habitat: Eastern United States.

PHIDIPPUS CARDINALIS Hentz.

Plate II, figure 4.

Syn.: 1844. Attus *cardinalis* Hentz, Journal Boston Soc. Nat. Hist., p. 386.

1875. Attus *cardinalis* id., Coll. of Arachn. Writ. ed. by Burgess, Boston, p. 51.

1883. Attus *cardinalis* Peckham, Descr. new or little known Attidæ, p. 31.

♂. Total length 9.5 mm. Width of abdomen 3 mm.

Cephalothorax: length 4.1; width 4; height 2.8.

Legs 11.1, 8.2, 8.2, 10.7; patella and tibia of the first 4.5; patella and tibia of the third, 3; patella and tibia of the fourth, 3.6; metartarsus and tarsus of the fourth, 3.3.

Lateral separated from middle eyes by ½ their own diameter; four anterior eyes looking downward. Clypeus ⅛ as high as middle eyes. Maxillæ enlarged and blunt at extremity with a projection at the outer corner, and parallel. Labium ½ as long as maxillæ, a little longer than wide, blunt and slightly contracted at tip. Sternum, widest in middle, ¼ longer than wide. Anterior coxæ separated by scarcely the width of the labium.

Coloration: Cephalothorax, abdomen, and venter entirely covered with brilliant red hairs; there are four indented dots on the anterior part of the abdomen, and sometimes two longitudinal black bands each with two red dots, extending from the middle of the dorsum to the spinnerets, and converging a little behind.

Habitat: Southern United States.

PHIDIPPUS MINIATUS Peckham.

Plate I, figures 6, 6a.

Syn.: 1883. Attus *miniatus* P., Descr. new or little known Attidæ of U. S., p. 15.

♀. Total length 13 mm. Width of abdomen 5 mm.

Cephalothorax: length 5.9; width 5; heighth 3.8.

Legs 13.5, 10.7, 10.7, 13.7; patella and tibia of the first, 5.5; patella and tibia of the third, 3.8; patella and tibia of the fourth, 5.1; metatarsus and tarsus of the fourth, 4.

Large ♀. Total length 18 mm.

Anterior row of eyes very little curved; lateral $\frac{1}{2}$ as large as middle eyes separated from them by $\frac{2}{3}$ their own diameter; dorsal a little smaller than lateral eyes, a little further from each other than from lateral borders. Clypeus about $\frac{1}{2}$ as high as middle eyes. Maxillæ enlarged and rounded at extremity, diverging. Labium a little more than $\frac{1}{2}$ as long as maxillæ, contracted and truncated at tip. Sternum not so wide as anterior coxæ. Anterior coxæ separated by width of labium. Relative length of legs 4, 1, 2, 3; no patellary spines.

Coloration: The cephalothorax has the eye-region covered with short, bright red hairs, intermixed with long black hairs, the latter forming small tufts between the small median and dorsal eyes; the thoracic part and sides are covered with coarse yellowish white hairs; the narrow lower margin is black. The abdomen has a wide band of gray hairs around the base, and is otherwise covered with short bright red, and long whitish hairs; at about the middle of the dorsum is a large somewhat triangular spot, and behind this are two others, not so large and transversely elongated, all of the same bright red color, and encircled by black rings; the sides are covered with long gray hairs. In specimens which are kept in alcohol the color becomes faded, the red changing to whitish yellow. The clypeus and palpi are covered with long white hairs; the legs are blackish, excepting the metatarsi, which are reddish brown; they are covered with gray hairs; under the femur is a stout fringe of hairs which extends less heavily on to the patella and tibia; the falces are dark, but very iridescent; the mouth-parts, sternum, and coxæ are dark brown or black; the venter has a wide central, longitudinal band black, limited by the gray hairs which come low on the sides; just at the apex, between the black band and the black spinnerets, is a narrow, transverse band of gray hairs.

Habitat: Florida. Texas.

PHIDIPPUS OBSCURUS Nov. Sp.

Plate I, figure 5. Plate II, figure 5.

(♀) Total length 13 mm. Width of abdomen 5.4 mm.

Cephalothorax: length 4.8; width 4.1; height 2.4.

Legs 9.3, 7.5, 7.7, 10; patella and tibia of the first 4; patella and tibia of the third 2.8; patella and tibia of the fourth 3.9; metatarsus and tarsus of the fourth 3.4.

Lateral eyes $\frac{1}{2}$ as large as middle eyes, and separated from them by $\frac{2}{3}$ their own diameter. Clypeus $\frac{1}{3}$ as high as middle eyes. Maxillæ wide at extremity with projection at outer corner. Labium $\frac{1}{2}$ as long as maxillæ, contracted and rounded at tip. Falces rather narrower than is usual in this genus, extending, in width only to the inner

edges of the lateral eyes. Sternum oval, convex. Anterior coxae separated by scarcely the width of the labium. Patellary spines on the second, third and fourth legs.

Coloration: Cephalothorax black, covered on the sides and above anterior row of eyes with white hairs, and having a transverse band of yellow hairs extending between the dorsal eyes. Abdomen with a dark brown band extending around the lower base and sides to apex; above this, at the base is a shorter curved pale band; central region of dorsum dark brown, changing toward the anterior portion to black, and marked, in this region with a pair of elongated white spots; behind these is a large white spot; behind this and near the apex is a pair of pale curved bands which take the form of a parenthesis, nearly meeting in the middle line. The dark central region of the dorsum surrounded excepting behind, by a pale region mottled with brown; opposite the large white spot on each side, is an oblique white band which extends downward through the encircling dark band. Legs and palpi brown, covered (especially the palpi) with white hairs. Venter pale, sternum, coxae and mouthparts brown, all clothed with white hairs. Falces iridescent green.

The curved white bands on the posterior part of the dorsum sometimes meet anteriorly, extending a little forward to form a chevron.

Habitat: Texas.

PHIDIPPUS McCOOKII Peckham.

Plate II, figure 9.

Syn.: 1883. Attus *McCookii* P., Descr. new or little known Attidæ of U. S., p. 16.

♀. Total length 14.4 mm. Width of abdomen 6 mm.

Cephalothorax: length 4.9; width 4.2; height 2.5.

Legs 10.7, 8, 8.2, 11; patella and tibia of the first 4; patella and tibia of the third 2.7; patella and tibia of the fourth 4.3; metatarsus and tarsus of the fourth 3.

Lateral eyes of the first row one-half as large as middle eyes, and separated from them by more than one-half their own diameter. Dorsal eyes, a little further from each other than from the lateral borders. Clypeus one-third as wide as middle eyes. Maxillæ parallel, enlarged and rounded at extremity. Labium nearly two-thirds as long as maxillæ, widest in middle, rather pointed. Sternum convex, about twice as long as wide. Anterior coxæ separated by a little less than the width of the labium. Relative length of legs 4, 1, 2, 3.

Coloration: Cephalothorax dark rufus covered with tawny hair. Abdomen golden yellow with short hairs of the same color; there are four indented dots near the base, and posterior to these two indistinct dark

bands extend to the apex; the sides are creased (the abdomen is distended with eggs in the only specimen which we have of this species). Clypeus and palpus dark rufus with long white hairs. Falces, mouthparts, sternum and legs dark rufus, the inner edges of maxillae and tip of labium being pale, and the legs having blackish bars. Venter golden yellow with three iridescent dark bands.

Habitat: Pennsylvania.

PHIDIPPUS ARIZONENSIS Peckham.

Plate I, figure 10. Plate II, figure 10.

Syn.: 1883. Attus *arizonensis* P., Descr. new or little known Attidæ of U. S., p. 13.

♂. Total length 11 mm. Width of abdomen 3 mm.

Cephalothorax: length 4.9; width 4.2; height 2.

Legs 11.4, 9.9, 9.9, 10.3; patella and tibia of the first 4.9; patella and tibia of the third 3.6; patella and tibia of the fourth 4.1; metarsus and tarsus of the fourth 3.

Cephalic part with sides very widely rounded.

Ocular area about one-half wider than long, this being relatively wider than is usual in *Phidippus*. Anterior lateral one-half as wide as middle eyes, and separated from them by their own diameter. Clypeus two-thirds as high as middle eyes. Dorsal eyes nearly twice as far from each other as from lateral borders. Maxillæ parallel, enlarged at extremity, with the outer corner sharp; labium one-half as long as maxillæ, rounded. Sternum as wide as intermediate coxæ. Anterior coxæ much stouter and longer than the others, and separated by the width of the labium. There are sometimes patellary spines on the four pairs. Abdomen long and slender, with its posterior face truncated; spinnerets turned downward.

Coloration: Cephalothorax velvety black, with two wide, white, lateral bands beginning just before and below the dorsal eyes and almost meeting in the middle of the thorax behind the depression. There is a band of grayish brown hairs above the anterior eyes, and a tuft of black hairs near each small median eye. Abdomen light brown; behind the middle is a median, longitudinal velvety black band, the truncated face, and the spinnerets being also black; in the middle of the dorsum is a pair of indented dots, and a second pair, just in front of these, is very indistinct; at the apex are two white spots one on each side of the black band; on each upper side of the abdomen is a black line extending to the apex; the under sides have wide white bands, formed of hairs directed downwards, which extend beneath on to the venter. The venter is velvety black, darkest behind, the white bands marking it off into a long triangle. Cly-

peus covered with white hairs; sternum, coxae and mouthparts black; falces black with some white hairs on the anterior surface; palpi and legs yellowish, excepting the femur I which is black above and pale beneath; third and fourth pairs darker than first and second, and showing some reddish rings on patella and tibia. All the legs have, on the under side, long, fine, yellow hair, which is strikingly long and thick on the first pair.

The abundance of fine yellowish hairs on the undersides of the first pair of legs, together with the great distance between the anterior lateral and large middle eyes distinguishes it from all other species of this genus.

Habitat: Arizona, Texas, California.

PHIDIPPUS ALBOMACULATUS Keys.

(Plate I, figure 13. Plate II, figure 13.)

Syn: 1885. Phidippus *albomaculatus* Keyserling, Neue Spinnen aus Amerika, vi, Verhandlungen Zoologisch-botanischen gesellschaft, p. 5 (491).

♀. Total length 13.4 mm. Width of abdomen 5.3 mm.

Cephalothorax: length 6; width 4.3; height 3.2.

Legs 13.5, 10.7, 10.6, 14; patella and tibia of the first, 5.6; patella and tibia of the third, 4; patella and tibia of the fourth, 5.3; metatarsus and tarsus of the fourth, 4.5.

Anterior lateral eyes scarcely one-half as large as middle eyes, and separated from them by two-thirds of their own diameter; dorsal eyes equally distant from each other and the lateral borders. Clypeus one-third as high as middle eyes. Maxillæ parallel, enlarged and rounded at extremity; labium a little more than one-half as long as maxillæ, oval, or a little contracted at tip. Sternum long, narrow, pointed in front, very convex. Anterior coxæ separated by less than the width of the labium. Relative length of legs, 4, 1, 3, 2; no patellary spines.

Coloration: Cephalothorax dark brown, entirely covered with short white hairs, and having some long, black and white hairs on the eye-region. Abdomen with a large, dark central region, in which is a median, forked, white band, and two pairs of white dots, while the sides have a mottled appearance, being covered with mixed white and brown hairs; usually there may be distinguished two or three oblique white bands extending downward over the sides. The pattern on the dorsum is frequently indistinct owing to the rubbing off of hairs; frequently all that appears is two dark longitudinal bands, on each of which are three or four white dots. Clypeus with a thick fringe of white hairs; falces most brilliantly iridescent; mouth-parts blackish; sternum, coxæ, and venter brown, covered with short, white hairs; palpi and legs yellowish brown, all covered with thick, long, white hair.

Habitat: United States.

PHIDIPPUS OPIFEX McCook.

Plate II, figure 11.

Syn.: 1873. Attus *opifex* McCook, Proc. Acad. Nat. Sci. of Philadelphia, p. 276.

♀. Total length, 15 mm. Width of abdomen, 7 mm.

Cephalothorax: length, 6.3; width, 4.9; height, 3.5.

Legs 13.3, 11.1, 10.4, 14.2; patella and tibia of the first, 5.2; patella and tibia of the third, 3.8; patella and tibia, fourth, 5.2; metatarsus and tarsus of the fourth, 4.7.

Quadrangle of eyes two-thirds wider than long. Lateral anterior eyes more than one-half as large as middle eyes, separated from them by two-thirds their own diameter. Middle eyes plainly separated. Clypeus one-half as high as middle eyes. Falces wider than the two middle eyes, three times as long as face, inclined forward, divergent. Maxillæ parallel, enlarged and blunt at extremity, slanting within toward labium. Labium one-half as long as maxillæ. Sternum projecting but little between anterior coxæ. Anterior coxæ separated by width of labium.

Coloration: Cephalothorax dark reddish, covered with white hair, and having a black marginal line. Clypeus and face covered with long white hairs. Abdomen black, covered with gray hair, with four white dots on the anterior part of the dorsum. Falces black with white hairs at base. Mouth-parts brown. Sternum, coxæ and venter covered with white hairs. Palpi light reddish brown, with long white hairs. Legs banded with black and dark reddish brown, with some white hairs, especially below. The hairs on cephalothorax, abdomen and venter are scale-like.

Habitat: California.

PHIDIPPUS JOHNSONII Peckham.

Plate I, figure 14. Plate II, figures 14, 14a.

Syn.: Attus *johnsonii* P., Descr. new or little known Attidæ of U. S., p. 22.

♂. Total length 10 mm. Width of abdomen 3.2 mm.

Cephalothorax: length 5.1; width 3.3; height 2.1.

Legs 10.9, 8.6, 8.9, 10.9; patella and tibia of the first, 4.8; patella and tibia of the third, 3.2; patella and tibia of the fourth, 4; metatarsus and tarsus of the fourth, 3.3.

Lateral eyes of first row one-half as large as middle eyes, and separated from them by half their own diameter. Clypeus half as high as middle eyes. Maxillæ parallel, with sharp outer corners, and slanting within toward the labium. Labium a little longer than wide, more than one-

half as long as maxillæ, contracted and rounded at tip. Sternum oval, half longer than wide. Anterior coxæ separated by width of labium. No patellary spines.

♀. Total length 12.2 mm. Width of abdomen 3.9 mm.

Cephalothorax: length 4.3; width 2.8; height 2.1.

Legs 10.4, 8.4, 8.4, 11.1; patella and tibia of the first, 4.3; patella and tibia of the third, 3.6; patella and tibia of the fourth, 4.5; metatarsus and tarsus of the fourth, 3.5.

Clypeus one-third as high as middle eyes. Maxillæ rounded. Sternum relatively wider than in ♂. Anterior coxæ separated by less than the width of the labium.

Coloration: ♂. Cephalothorax jet black, sometimes with a few short bright red hairs (perhaps, in a fresh state, entirely covered with these). Abdomen bright vermillion red, sometimes with a white band at base; clypeus dark with a fringe of white hairs; palpus black; falces dark but iridescent; maxillæ and labium brown; sternum black with white hairs; venter dark brown with white hairs; legs dark rufus barred with black. ♀. Abdomen with a white band at base, and a wide central longitudinal black band, upon which are three pairs of white dots.

This species is nearest *cardinalis;* it is, however, not so high; its color is crimson rather than scarlet; and on the anterior inner edge of the falx is a sharp, rather long point, which in *cardinalis* is but little developed. The cephalothorax in *cardinalis* is covered with scarlet hairs, in *johnsonii* it is jet black. The latter also has on the palpi of the first pair of legs many white, rice-like scales or hairs.

Habitat: Washington Territory.

PHIDIPPUS OCTO-PUNCTATUS Peckham.

Plate II, figure 15.

Syn.: 1883. P. *octo-punctatus* Peckham, Descr. new or little known Attidæ of U. S., p. 6.

♂. Total length 8 mm. Width of abdomen 2.8 mm.

Cephalothorax: length 3.1; width 3; height 2.3.

Legs 8.4, 5.6, 5.9, 7.9; patella and tibia of the first, 3.2; patella and tibia of the third, 2; patella and tibia of the fourth, 2.9; metatarsus and tarsus of the fourth, 2.8.

Lateral anterior a little more than $\frac{1}{2}$ as large as middle eyes, separated from them by $\frac{1}{2}$ their own diameter. Clypeus $\frac{2}{3}$ as high as middle eyes. Falces wider than first row of eyes, three times as long as face. Maxillæ short, truncated, with projection at outer corner, inclined toward labium. Labium $\frac{1}{2}$ as long as maxillæ, $\frac{1}{2}$ longer than wide, contracted and blunt at tip. Anterior coxæ separated by more than width of labium.

Coloration: Cephalothorax above, black covered with short white hairs, sides dark brown with some irregular whitish spots and sparse yellowish hairs, the lower margin being slightly darker; there are some long yellow hairs on the eye-region. Clypeus dark brown mottled with white, with a few yellowish hairs. Abdomen black covered with short white hairs and longer yellowish hairs; near the base is a short curved white line, posterior to which are two longitudinal rows of white spots, four spots in each row; these are divided into two anterior and two posterior pairs, the four posterior spots being obliquely elongated; on the posterior sides are two or three short oblique white lines. Falces, mouth-parts, sternum, coxæ and legs dark brown. Venter black with short yellowish hairs.

Habitat: Missouri.

PHIDIPPUS RAUTERBERGII Nov. Sp.

Plate I, figure 8. Plate II, figure 8.

♀. Total length 16 mm. Width of abdomen 7.3 mm.

Cephalothorax: length 6.2; width 5.8; height 3.8.

Legs 15.3, 11.3, 11.3, 15.2; patella and tibia of the first, 6.4; patella and tibia of the third, 4.4; patella and tibia of the fourth, 6; metatarsus and tarsus of the fourth, 5.1.

Cephalothorax nearly plane; ocular area much wider behind; anterior lateral one-half as large as middle eyes, and separated from them by a little more than one-half their own diameter; eyes of second row more than twice as far from dorsal as from lateral eyes; third row of eyes considerably narrower than the cephalothorax at that place; clypeus one-third as high as the middle eyes. Maxillæ wide, parallel, rounded. Labium one-half as long as maxillæ, but little longer than wide, blunt at tip. Sternum oval, convex in front, less than twice as long as wide, projecting but little between the anterior coxæ, which are separated by less than the width of the labium. Relative length of legs $\overline{4, 1}, \overline{2, 3}$; no patellary spines.

Coloration: Cephalothorax dark reddish brown, almost black in the eye-region, with some short white hairs on the sides and between the dorsal eyes. Abdomen mottled with brown and white, with two black spots on the anterior portion, and one large irregular black spot in the middle from which two black bands extend to the apex; in the middle of the black spot is a large white spot, and on the black bands, is a pair of smaller white spots; there are sometimes two white dots nearer the apex, and a white spot on the inner side of each of the black spots on the anterior part of the dorsum, while the space between the black bands is occupied by a series of white and brown chevrons. Clypeus brown; palpus brown with three white rings;

falces iridescent: mouth-parts, sternum, and coxæ reddish brown; venter with two white longitudinal bands enclosing a darker central region; legs black, barred with dark red, with short white hairs, and a heavy fringe of black hairs on the underside of the tibia of the first.

Habitat: Texas.

PHIDIPPUS MEXICANUS Nov. Sp.

Plate II, figure 7.

♂. Total length 11.4 mm. Width of abdomen 5 mm.

Cephalothorax: length 6.5; width 5; height 3.6.

Legs 16.3, 12.7, 11.2, 14.5; patella and tibia of the first, 6.7; patella and tibia of the third, 4; patella and tibia of the fourth, 5.3; metatarsus and tarsus of the fourth, 4.8.

Cephalothorax widely rounded. First row of eyes much curved; lateral separated from middle eyes by one-half their own diameter. Clypeus one-fourth as high as large middle eyes. Falces wider than first row of eyes, more than twice as long as face. Maxillæ long, widened and truncated at extremity, with projection at outer corner, cut obliquely on inner side, and excavated for labium. Labium less than half as long as maxillæ, contracted and blunt at tip. Sternum one-half longer than wide. Anterior coxæ separated by a little less than width of labium.

Coloration: Cephalothorax probably covered with snowy white hairs, excepting a dark brown band around the margin; in our specimen these hairs are largely rubbed off. Clypeus with white hairs. Abdomen black with a hairy white band at base, a large central white spot behind middle, and posterior to this an interrupted, curved, white band. Falces brilliant iridescent green. Palpi covered with white hairs. Legs very hairy; femoral and tibial joints with black, other joints with white hairs. Other parts all black.

From the collection of Count Keyserling.

Habitat: Mexico.

PHIDIPPUS INSOLENS Hentz.

Plate I, figure 12. Plate II, figures 12, 12a.

Syn.: 1844. Attus *insolens* Hentz, Journal Bost. Soc. Nat. Hist., Vol. IV.
1845. " *podogrosus* id., ibid., Vol. V.
1875. " *insolens* id., Coll. Arach. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 51.
1875. " *podogrosus* id., ibid., p. 61.
1877. Phidippus *coloradensis* Thorell, Descr. Araneæ coll. in Colorado, p. 523.

♂. Total length 9.5 mm. Width of abdomen 3 mm.

Cephalothorax: length 5; width 4; height 2.4.

Legs 14, 9, 8, 10.2; patella and tibia of the first, 6.3; patella and tibia of the third, 2.8; patella and tibia of the fourth, 3.2; metatarsus and tarsus of the fourth, 3.

Small ♂. Total length 6.8 mm.

♀. Total length 12mm. Width of abdomen 4.5.

Cephalothorax: length 4.8; width 4; height 2.5.

Legs 9.2, 7.8, 8, 10; patella and tibia of the first, 4.2; patella and tibia of the third, 3; patella and tibia of the fourth, 4; metatarsus and tarsus of the fourth, 3.3.

Anterior lateral separated from middle eyes by one-half their own diameter. Middle nearly twice as large as lateral eyes, and a little separated. Clypeus one-third as high as middle eyes. Maxillæ long inner margin oblique, ♂ with marked apophysis on outer corner, ♀ enlarged and blunt at extremity. Sternum nearly twice as long as wide. Anterior coxæ separated by less than the width of the labium.

Coloration: Cephalothorax covered with bright red hairs excepting the lower margin which has a white line above a black line; the ♀ has a tuft of black hairs on the outer side of each lateral eye. Clypeus with some long white hairs. Abdomen with a silvery white band at base behind which is a deep black band; the dorsum is of a bright red color, which is interrupted in the posterior two-thirds by a central, longitudinal, angular, black band which is contracted behind, upon which, in the posterior part, are two pairs of white dots; the sides are black with two curved white bands. Palpi ♂ black, conspicuously marked by a silvery white line along the upper surface. ♀ reddish with long white hairs. Falces brilliant iridescent green, those of the ♂ with a slight brownish tinge; fang black. Mouthparts dark brown. Sternum and coxæ black with white hairs. Venter deep black with white hairs on the sides, and, in the center, a wide somewhat triangular band (narrowing behind), of a clear silvery white color. Legs banded with black and rufus. In the ♂ the first leg has fringes of black hairs; in the ♀ the same leg is covered with long white hairs.

The hairs in this species seem to rub off even more easily than is usual with the Attidæ. When they are gone the spider appears as in Hentz's drawing.

In general appearance *insolens* is much like *Philœus rimator*, but may be distinguished by the difference in the shape of the cephalothorax, and the position of the eyes.

Habitat: Georgia, Florida, Colorado.

PHIDIPPUS OTIOSUS Hentz.

Plate I, figure 15. Plate II, figure 15 a.

Syn.: 1845. Attus *otiosus* Hentz, Journal Boston Soc. Nat. Hist., Vol V.
1875. Attus *otiosus* id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 59.

♀. Total length 11.5 mm. Width of abdomen 4 mm.

Cephalothorax: length 5; width 4; height 2.5.

Legs 9.6, 7.5, 8, 10; patella and tibia of the first 4; patella and tibia of the third, 3.4; patella and tibia of the fourth 4; metartarsus and tarsus of the fourth, 3.8.

Lateral eyes of first row one-half as large as middle eyes and separated from them by one-third their own diameter. Clypeus one-half as high as middle eyes. Maxillæ enlarged and rounded at extremity. Labium two-thirds as long as maxillæ. Falces nearly as wide as first row of eyes, as long as face, vertical, diverging. Sternum, very deepset, oval, projecting between the anterior coxæ which are separated by the width of the labium.

Coloration: A wide band of white hairs extends across the clypeus and on to the sides, under the eyes, nearly encircling the cephalothorax; above is a black band which occupies the cephalic part, but grows narrower on the thoracic, where the white band curves upward. On each side of the cephalothorax are two tufts of black hairs, one between the eye of the second row and the dorsal eye, and one just behind and below the anterior lateral eye. Abdomen black with a band of long white hairs at base, and several lines of white hairs on each side; on the anterior part of the dorsum are two white dots; on he middle part and nearer together, are two larger white spots; near the apex are two large curved spots of a light yellowish red color; these with the white spots, and the lines on the sides mark off a somewhat irregular black figure on the posterior part of the dorsum. Falces darkly iridiscent with a fringe of white hairs at their insertion. Palpi and legs black with long white hairs. Mouth-parts, sternum, coxæ and venter black, the venter nearly encircled by white hairs which form wide white bands on the sides, and with two white spots in the middle.

This is a very hairy species, in this respect, and in its general coloring, resembling *P. galathea.*

Habitat: Georgia, Alabama.

PHILÆUS (Thorell).

Cephalothorax high and convex, contracted in front and behind, sides rounded, cephalic part inclined forward, thoracic part slanting, at first gradually, and then more steeply from dorsal eyes. Ocular area

at least one-third wider than long, wider behind than in front; anterior row of eyes more or less curved, the middle slightly separated, the lateral at least one-half as large, separated from the middle by from one-third to two-thirds their own diameter; eyes of second row very slightly nearer the lateral than the dorsal eyes; dorsal as large or nearly as large as the lateral eyes, at least as far from each other as from the lateral borders, forming a row narrower than the cephalothorax at that place. Clypeus not more than half as high as middle eyes. Labium about one-half as long as maxillæ, usually longer than wide, sometimes as wide as long. Anterior coxæ separated by width of labium or by a little less. Legs (♂) 1, 2, 4, 3. 1, 4, 2, 3. 1, 4, 3, 2; (♀) 1, 4, 2, 3. 1, 4, 3, 2. 4, 1, 3, 2; first pair stoutest, second next. Femur and tibia of the first enlarged, stouter than patella and much stouter than metatarsus and tarsus; tibia and patella of the third shorter than tibia and patella of the fourth. Femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth usually spined throughout their length.

This genus differs from *Phidippus* in having the eyes of the second row nearly half way between the lateral and dorsal eyes; the width of the ocular area, moreover, is frequently greater in proportion to its length.

PHILÆUS FARNEUS Nov. Sp.

Plate II, figure 16.

♀. Total length 9.2 mm. Width of abdomen 3.2 mm.

Cephalothorax: length 4; width 3.4; height 2.1.

Legs 8.4, 6.6, 7.2, 9.2; patella and tibia of the first, 3.6; patella and tibia of the third, 2.8; patella and tibia of the fourth, 3.6; metatarsus and tarsus of the fourth, 3.1.

Cephalic part plane, and but little inclined; thoracic convex, falling abruptly a little way behind dorsal eyes. Ocular area one-third wider than long, much wider behind than in front. Anterior eyes small, in a moderately curved row; lateral one-half as large as middle eyes, separated from them by two-thirds their own diameter; dorsal a little smaller than lateral eyes, further from each other than from lateral borders. Clypeus one-third as high as middle eyes, vertical; falces as wide as first row of eyes, twice as long as face, vertical, diverging. Maxillæ parallel, enlarged and rounded at extremity. Labium a little more than one-half as long as maxillæ, about twice as long as wide, contracted and blunt at tip. Sternum twice as long as wide, deepset, a little rounded behind. Anterior coxæ separated by less than width of labium.

Coloration: Cephalothorax black with long stiff black hairs on the eye-region, which form one or two small tufts on each side. Clypeus covered with short white hairs. Abdomen black, encircled except at

apex by a scalloped white band; on the middle of the dorsum is a large triangular white spot, in front of, and behind which are two white dots; near the apex, extending upward from the encircling band, are two short oblique white bars. Palpi reddish with long white hairs. Falces iridescent purple. Mouth-parts, sternum and coxæ dark brown. Venter black in the middle with a whitish longitudinal band on each side. Legs dark brown with long black and gray hairs.

Habitat: Texas.

PHILÆUS FARTILIS Nov. Sp.

Plate II, figure 17.

♀. Total length 10 mm. Width of abdomen 4 mm.

Caphalothorax: length 4.4; width 3.8; height 2.4.

Legs 9, 7.2, 7.3, 9.5; patella and tibia of the first, 4; patella and tibia of the third, 2.8; patella and tibia of the fourth, 3.6; metatarsus and tarsus of the fourth, 3.3.

Ocular area one-third wider than long; anterior eyes small, in a slightly curved row; middle eyes more than twice as large as lateral eyes, separated from them by one-half the diameter of the lateral; dorsal as large as lateral eyes, further from each other than from lateral borders. Clypeus one-third as high as middle eyes, vertical. Falces as wide as first row of eyes, more than twice as long as face, vertical, slightly diverging. Maxillæ divergent, enlarged and rounded at extremity, excavated on inner side for labium. Labium a little more than one-half maxillæ, one-half longer than wide, a little contracted and truncated at tip. Sternum one-half longer than wide, rather deep set. Anterior coxæ separated by less than width of labium. Legs 1, 4, 2, 3; metatarsi of the third and fourth with only terminal circles of spines.

Coloration: Cephalothorax and clypeus covered with long white hairs, the former with a black marginal line. Abdomen gray except the posterior part which is blackish; the base and anterior sides are white; there is a large irregular reddish spot on each side, and on the dorsum are indistinctly marked three pairs of white spots. Near the apex on each lower side is a wide white band, and on the upper surface is a white parenthesis, the black region enclosed having a pair of white dots. Falces black, the upper part being covered with long white hairs. Mouth parts, sternum and coxæ, black. Venter white with a wide, central, longitudinal black band. Legs and palpi dark brown covered with long white hairs.

Habitat: Mexico.

PHILÆUS MEXICANUS Nov. Sp.

Plate I, figure 18. Plate II, figure 18.

♀. Total length 10 mm. Width of abdomen 3.1 mm.

Cephalothorax: length 4; width 3.2; height 2.

Legs 8.3, 6.4, 6.4, 7.8; patella and tibia of the first, 3.4; patella and tibia of the third, 2.8: patella and tibia of the fourth, 3.2; metatarsus and tarsus of the fourth, 2.4.

Ocular area occupying nearly two-fifths of cephalothorax, one-third wider than long; anterior row of eyes very little curved; lateral one-half as large as middle eyes, separated from them by one-half their own diameter; middle eyes sub-touching; dorsal as large as lateral eyes, equally distant from each other and the lateral borders. Clypeus a little inclined, one-fifth as high as the middle eyes. Falces stout and rather long, inclined forward, and somewhat diverging. Maxillæ parallel, enlarged and rounded at extremity; labium two-thirds as long as the maxillæ, pointed. Sternum convex, nearly as wide as long, truncated in front. Anterior coxæ separated by scarcely the width of the labium, much the stoutest and longest. First legs much the stoutest.

Coloration: Cephalothorax dark brown in the thoracic region, and blackish on the cephalic plate; the lower margin has a fine black line between two fine white lines; there is a wider band of white hairs which passes around the face and extends on the sides, below the second and third rows of eyes, to the posterior margin. Dorsum of the abdomen bronze brown; a little behind the middle are four white dots, two on each side. Around the base is a wide white band; on each side, opposite the dots, is a large white spot; on each side, near the apex, is a short, wide, ribbon-like white band, extending from below on to the dorsum, and bifurcating at the end; this makes a diamond-shaped figure of the bronze color, which connects a small bronze-colored region at the apex with the larger region of the same color on the anterior part of the dorsum. First and second pairs of legs darkest in color; all the legs brown, banded with blackish; tibia of the first leg black with a fringe of black hairs below. Clypeus covered with gray hairs. Falces dark brown. Mouthparts, coxæ, sternum, and venter, brown, thinly covered with gray hairs.

Habitat: Mexico.

PHILÆUS MILITARIS Hentz.

Plate I, figures 19, 19a. Plate II, figures 19, 19a.

Syn.: 1844. Attus *militaris* H., Journal Bost. Soc. Nat. Hist., Vol. IV.
1846. Eris *aurigera* (♂) C. K., Die Arachn., XIII, p. 189.
? 1846. Phidippus *asinarius* id., ibid., XIII, p. 139.
1875. Attus *militaris* H., Coll. Arachn. Writ. by N. M. Hentz, ed. by Burgess, Boston, p. 62.

♂. Total length 6 mm. Width of abdomen 1.9 mm.

Cephalothorax: length 2.1; width 1.9; height 1.8.

Legs 7.5, 3.8, 3.9, 4.6; patella and tibia of the first, 3.2; patella and tibia of the third, 2.1; patella and tibia of the fourth, 2.1; metatarsus and tarsus of the fourth, 2.1.

Falces 1.6.

Ocular area one-third wider than long; anterior eyes small, lateral more than one-half as large as middle eyes, and separated from them by one-half their own diameter; dorsal a little smaller than lateral eyes, and further from each other than from the lateral borders. Clypeus one-fourth as high as middle eyes. Falces nearly as wide as the first row of eyes, long, inclined forward, and diverging, fang long. Maxillæ narrow at base, wider at extremity, long, truncated, slanting on the inner edge, and excavated for labium; labium less than one-half as long as maxillæ, longer than wide, a little contracted and rounded at the extremity. Sternum nearly twice as long as wide, truncated in front and rounded behind. Anterior coxæ separated by scarcely the width of the labium.

♀. Total length 9.4 mm. Width of abdomen 4.1 mm.

Cephalothorax: length 3.2; width 2.4; height 1.6.

Legs 5.9, 4.7, 4.7, 5.7; patella and tibia of the first, 2.1; patella and tibia of the third, 1.8; patella and tibia of the fourth, 1.9; metatarsus and tarsus of the fourth, 1.9.

Falces parallel and vertical, shorter and less robust than in ♂; fang short. Maxillæ enlarged and rounded at extremity; labium more than one-half as long as maxillæ, twice as long as wide.

Coloration: ♂. Cephalothorax and abdomen bright bronze brown, the former with a wide white band on each upper side, and a white spot in the middle of the eye region, the latter with a wide white band around the base and sides, and sometimes two rows of white dots on the dorsum; clypeus, falces, palpi, mouthparts and sternum dark brown; venter brown, covered with short white hairs; legs brown, with femur of the first very dark, and proximal parts of the femora of the second, third and fourth, and all the coxæ, light yellowish.

♀. Cephalthorax bronze, nearly covered with gray hairs, the abdomen with a whitish band down the middle, and four pairs of more or less elongated white spots; the lower sides are nearly white; clypeus covered with long white hairs; falces, mouthparts and sternum brown; venter brown with short white hairs and a darker central region; legs and palpi light brown, with white hairs.

Habitat: United States, Mexico.

PHILAEUS CHRYSIS Walck.

Plate I, figure 20. Plate II, figure 20. Plate III, figure 20a.

Syn.: 1837. Attus *chrysis* (♂) Walck., Hist. Nat. des Insectes Aptères, I, p. 454.

1837. " *iris* (♀) Walck., id., ibid., p. 455.

1846. Plexippus *aurecalceus*, C. K., Die Arachniden, XIII, p. 113.

1847. Attus *chrysis* Walck., Hist. Nat. des Insectes Aptères, IV, p. 422.

1847. " *iris*, id., ibid., p. 423.

♂. Total length 9 mm. Width of abdomen 2.8 mm.

Cephalothorax: length 3.9; width 3.5; height 2.8.

Legs 13.7, 9.5, 9.4, 10.9; patella and tibia of the first, 5.7; patella and tibia of the third, 3.4; patella and tibia of the fourth, 4.4; metatarsus and tarsus of the fourth, 3.2.

Falces 3 mm.

Ocular area one-third wider than long; anterior row of eyes very little curved; lateral rather more than one-half as large as middle eyes, and separated from them by one-half their own diameter; dorsal smaller than lateral eyes, and equally distant from each other and the lateral borders. Clypeus one-fourth as high as middle eyes. Falces compressed, as wide as the middle eyes, two and one-half times as long as the face, inclined forward, and diverging; the fang is two-thirds as long as the falx. Maxillæ parallel, long, truncated, with a projection at the outer corner; labium blunt, one-half longer than wide, and one-half as long as the maxillæ. Sternum truncated in front, rounded behind, one-fourth longer than wide. Anterior coxæ separated by width of labium. Relative length of legs 1, 4, 2, 3.

♀. Total length 10.9 mm. Width of abdomen 4.2 mm.

Cephalothorax: length 4.2: width 3.8; height 2.1.

Legs 9.2, 7.9, 8.1, 9.4; patella and tibia of the first, 4.1; patella and tibia of the third, 2.8; patella and tibia of the fourth, 3.5; metatarsus and tarsus of the fourth, 3.

Falces 1.9 mm.

Falces vertical, parallel, and not so long as in ♂; maxillæ rounded; labium more than one-half as long as maxillæ; anterior coxæ separated by more than the width of the labium. Relative length of legs 4, 1, 3, 2.

Coloration: As well as it can be distinguished from our badly rubbed specimens, the coloration is as follows: ♂, cephalothorax black; abdomen black, encircled, excepting at the apex, by a white band, and with two pairs of white spots, or rather of short transverse white lines, on the posterior part of the dorsum; the under side of the body, and the legs, black, or very dark brown. ♀, cephalothorax black; abdomen covered with golden scales, with a white band around the

anterior margin which extends on to the sides, a short oblique white line on each side at the termination of this band, and posterior to these lines, on each side a semi-circular band, white; the dorsum has, on the anterior part, four indented dots, and on the posterior part, opposite the oblique lines one pair of short transverse white lines like those of the ♂; the mouthparts and falces are black, the sternum and coxæ dark brown; the venter is brown with a central longitudinal white band; the legs are light brown excepting the femoral, patellary, and tibial joints of the first pair, which are black.

Habitat: Mexico, Guatemala. (South Carolina, Georgia, Walckenaer.)

PHILÆUS PRINCEPS Peckham.

Plate III, figure 21.

Syn.: 1883. Attus *princeps* P., Descr. new or little known Attidæ of U. S., p. 18.

♀. Total length 8.1 mm. Width of abdomen 3 mm.

Cephalothorax: length, 3.9; width, 3.2; height, 2.

Legs 7.1, 5.9, 6, 7.5; patella and tibia of the first, 3.4; patella and tibia of the third, 2; patella and tibia of the fourth, 2.6; metatarsus and tarsus of the fourth, 2.4.

Ocular area nearly twice as wide as long, and much wider behind; anterior row a little curved, the eyes composing it being unusually small, the lateral about one-half as large as the middle, and separated from them by nearly two-thirds their own diameter; dorsal almost as large as lateral eyes, and further from each other than from the lateral borders. Clypeus, one-third as high as middle eyes. Falces as wide as the first row of eyes, nearly twice as long as the face, vertical, slightly diverging. Maxillæ parallel, enlarged and blunt at extremity, slanting on the inner edge to the labium: labium less than one-half as long as maxillæ, as wide as long, a little contracted and truncated at tip. Sternum deep set, small, one-half longer than wide, widest in the middle. Anterior coxæ separated by less than the width of the labium. Relative length of legs, 4, 1, 3, 2.

Coloration: ♀. Cephalothorax dark rufus, covered with short yellowish white hairs, and having some long black hairs on the eye region; abdomen covered with coarse tawny and gray hairs, with a whitish band at base, and two gray spots, one on either side of the middle point of the dorsum. Clypeus with thick white hairs; falces darkly iridescent; mouthparts brown; maxillæ tipped with white; sternum black; venter with grayish yellow hairs; legs, palpi, and spinnerets bright reddish brown, the legs and palpi with white hairs.

Habitat: Pennsylvania.

PHILÆUS RIMATOR Walck.

Plate I, figure 22.

Syn.: 1837. ? Attus *rimator* Walck., Hist. Nat. des Insectes Aptères, I, p. 446.
1846. Phidippus *auctus* C. K., Die Arachniden, XIII, p. 148.
1847. Attus *rimator* Walck., His. Nat. des Insectes Aptères, IV, p. 422.
1883. " *formosus* Peckham, Descr. new or little known Attidæ, of U. S., p. 23.

♀. Total length 8.4 mm. Width of abdomen 2.9 mm.

Cephalothorax: length 4; width 2.9; height 2.

Legs 7, 5.2, 4.9, 7.5; patella and tibia of the first, 3; patella and tibia of the third, 1.7; patella and tibia of the fourth, 2,7; metatarsus and tarsus of the fourth, 2.

Ocular area one-third wider than long: anterior row of eyes slightly curved; lateral rather more than one-half as large as middle eyes, and separated from them by two-thirds their own diameter; eyes of this row unusually small; eyes of second row very minute; dorsal eyes a little smaller than the lateral, and placed further from each other than from the lateral borders. Clypeus one-half as high as middle eyes. Falces as wide as the first row of eyes, once and one-half as long as the face, vertical and a little divergent. Maxillæ parallel, enlarged and blunt at extremity, cut a little on the inner edge; labium one-half as long as maxillæ, twice as long as wide, contracted and rounded at tip. Sternum deepset, oblong, narrow in front, one-half longer than wide. Anterior coxæ separated by scarcely the width of the labium.

Coloration: ♀. Cephalothorax and abdomen covered with bright red hairs, the abdomen with a white band around the base, and a wide, central, longitudinal. black band which begins in front of the middle of the dorsum and extends around the lower, posterior sides; upon this band are three pairs of white dots. Clypeus and palpi covered with red hairs; falces brilliant green; mouthparts, sternum and coxæ varying from brown to black; venter black; legs brownish with some red hairs.

Habitat: Pennsylvania, Florida, Iowa.

PLEXIPPUS PUERPERUS Hentz.

Plate I, figures 23, 23a. Plate II, figure 23a. Plate III, figure 23b.

Syn.: 1845. Attus *puerperus* Hentz, Journal Boston Soc. Nat. Hist., Vol. V.

1845. " *sylvanus* id., ibid., Vol. V.

1846. Alcmena *pallida* C. K., Die Arachn., XIII, p. 179.

1874. Attus *branickii* Tacz., Les Araneides de la Guyane française, Horae Soc. Entomol. Ross. T., VIII, p. 94.

1875. Attus *puerperus* Hentz, Coll. Arachn. Writ. Ed. by Burgess, p. 64.

1879. Marpissa *branickii* Tacz., Les Aranéides du Pérou. Bull. Soc. Imp. des Nat. de Moscou. T. LIII, p. 227.

1883. Attus *agrestis* Peckham, Descr. new or little know Attidæ of U. S., p. 12.

1885. Plexippus *puerperus* id., Proc. Nat. Hist. Soc. of Wisconsin, p. 68.

As Dr. Taczanowski has kindly sent us specimens of his *Attus branickii* we have been able to compare them with *puerperus* Hentz. They are undoubtedly identical. We have the same spider in our own collection, from Central America.

♂. Total length[1] 11 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 4; width 2.4; height 2.8.

Legs 12.3, 10.3, 10.5, 10.8; patella and tibia of the first 5.4; patella and tibia of the third 3.9; patella and tibia of the fourth, 3.8; metatarsus and tarsus of the fourth, 3.9.

♀. Total length 13.6 mm. Width of abdomen 4.7 mm.

Cephalothorax: length 4.8; width 4.2; height 2.8.

Legs 10.6, 9.1, 10.4, 11.7; patella and tibia of the first, 4.8; patella and tibia of the third, 3.9; patella and tibia of the fourth, 4.1; metatarsus and tarsus of the fourth, 4.3.

Cephalothorax high, rounded on the sides and widest behind the dorsal eyes. The cephalic part occupies two-fifths of the cephalothorax; it is nearly plane and slightly inclined. The thoracic part is somewhat rounded but falls steeply from the dorsal eyes. The ocular area is one-fourth wider than long and is a little wider behind than in front. The anterior row is moderately curved: the middle eyes are sub-touching and are scarcely twice as large as the lateral eyes, the lateral being separated from the middle by one-third their own diameter. The eyes of the second row are placed not quite as far from the dorsal as from the lateral eyes. The dorsal eyes are a little smaller than the lateral eyes and are placed by more than their own diameter in-

[1] The size of the male is very variable, ranging from 5.6 mm., total length, to 11 mm.

side the margin: they are further from each other than from the lateral borders. The clypeus is one-third as high as the large middle eyes. The falces are stout, being a little wider than the first row of eyes, and are flattened in front; they are nearly twice as long as the face, parallel and vertical. The fang is short. The maxillæ are long and parallel, enlarged and slightly rounded at the extremity. The labium is but little longer than wide, a little more than one-half the maxillæ, contracted and rounded at the tip. Sternum one and one-half times as long as wide, truncated in front and rounded behind. It projects between the anterior coxæ which are separated by the width of the labium. Legs, relative stoutness, first, second, third, fourth, the fourth being plainly more slender than the third. There are femoral, patellary, tibial and metatarsal spines on the four pairs, those on the tibiæ and metatarsi of the third and fourth being found both above and below, and those on the metatarsi extending to the base. The ♀ has no patellary spines on the first and second pairs.

Coloration: (♂.) The cephalothorax varies from reddish brown to black and has on the dorsum a central spot of white, two white lines on each side near the posterior border, running upward from the lower margin, and just behind and below each dorsal eye two short parallel white lines; the abdomen varies from light testaceous to dark brown and has on the dorsum two longitudinal white bands; on each side of the bands are some scattered black dots. The legs and falces are dark brown; the clypeus is dark brown above with a pale band just over the falces; on the upper portion two lines of white hairs beginning between the middle eyes run obliquely outward to the insertion of the palpi; the palpus is brown, with a white line above, meeting that on the clypeus. The sternum, coxæ and mouthparts vary from light testaceous to dark brown; the venter is brown with a longitudinal white line on each side. (♀) The cephalothorax is yellow, darkest in the eye region, the eyes are jet black, the small middle eye is on a black spot, thus offering a striking contrast to the light yellow of the cephalothorax; there is a brown spot just above the anterior middle eyes; the abdomen is light yellow with three longitudinal white bands, the middle band often less distinct, and many black dots. The legs, palpi, falces and clypeus are yellow, the sternum, coxæ and venter pale brown, the venter having a line of white hairs on each side.

Habitat: California, Florida, Texas, Georgia (Gentry collection), Mexico, Guatemala, New Grenada (in collection of Count Keyserling), Brazil.

PLEXIPPUS PUTNAMII Peckham.

Plate III, figure 24.

Syn.: 1883. Attus *putnamii* P., Descriptions of new or little known Attidæ, p. 1.

♂. Total length 9 mm. Width of abdomen 3.6 mm.

Cephalothorax: length 4.5; width 3.3; height 2.3.

Cephalothorax high, convex, widest just behind dorsal eyes; cephalic a little shorter than thoracic part; rounded on the sides and slanting abruptly behind. Ocular area nearly twice as wide as long; wider behind than in front; anterior row of eyes a little curved; lateral $\frac{1}{2}$ as large as middle eyes, and separated from them by $\frac{2}{3}$ their own diameter, while the middle eyes are slightly separated from each other; eyes of the second row a very little nearer the lateral than the dorsal eyes: dorsal nearly as large as lateral eyes, further from each other than from the lateral borders, forming a row which is a little narrower than the cephalothorax at that place. Clypeus $\frac{1}{3}$ as high as middle eyes. Falces extending in width to inner edges of lateral eyes, square, $1\frac{1}{2}$ times as long as the face, vertical, parallel; fang small. Maxillæ parallel, truncated at tip, cut obliquely on the inner edges; labium $\frac{1}{2}$ as long as maxillae, as wide as long, pointed. Sternum very deep-set, oval, projecting between the anterior coxæ, which are separated by less than the width of the labium. Relative length of legs 4, 3, 1, 2; first and second pairs stoutest. Femur of the first rather short, narrow at the ends, and much enlarged below, in the middle. All the legs have femoral, tibial and metatarsal spines, and there are patellary spines on the third and fourth; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax reddish brown; there is a large white spot just behind the dorsal eyes, and a short white band on each side of the eye-region extending from the smaller median to the dorsal eyes; just back of the small median eye is a tuft of black hairs; there are thick, light brownish hairs above the anterior row of eyes. Abdomen light reddish brown, encircled by a white band; near the apex two short, transverse, parallel, white bars, on each side, extend from the encircling band toward the middle of the abdomen; at about the middle point of the dorsum is a large white spot, and near the base are two small, indistinct, white spots formed by a few white hairs. Clypeus covered with short red and long white hairs. Palpus brownish, with black and white hairs. Mouthparts, sternum and coxæ dark brown, sternum and coxæ covered with white hairs. Venter covered with whitish hairs, with a central, longitudinal, darker band. Legs brownish red with many long white hairs.

Habitat: Iowa.

DENDRYPHANTES CAPITATUS Hentz.

Plate I, figures 25, 25a. Plate III, figure 25a.

Syn.: 1844. Attus *capitatus* H., Journal Bost. Soc. Nat. Hist., Vol. IV.
1845. Attus *parvus* (♀) id., ibid, Vol. V.
1875. Attus *parvus* (♀) id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 62.
1875. Attus *capitatus* id., ibid., p. 51.
1883. Attus *œstivalis* Peckham, Descr. new or little known Attidæ of U. S., p. 2.

♂. Total length 4.8 mm. Width of abdomen 1.4 mm.

Cephalothorax: length 2.1; width 1.5; height 1.2.

Legs 4.1, 3, 2.6, 3.9; patella and tibia of the first, 1.9; patella and tibia of the third, 9; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 9.

Cephalothorax high, convex, slightly dilated behind dorsal eyes; cephalic part inclined, but little shorter than thoracic. Ocular area one-third wider than long, a little wider behind than in front; first row of eyes a little curved; lateral a little less than one-half as large as middle eyes, and slightly separated from them; middle eyes sub-touching; eyes of second row a very little nearer lateral than dorsal eyes; dorsal eyes further from each other than from lateral borders. Clypeus one-third as high as middle eyes, retreating. Falces extending to inner edges of lateral eyes, flattened, once and a half as long as face, vertical, somewhat diverging; fang moderately long and stout. Maxillæ parallel, long, enlarged and rounded at extremity, with a projection at the outer corner; labium less than half as long as maxillæ, contracted and rounded at tip. Sternum oval, twice as long as wide, narrow at both ends. Anterior coxæ separated by a little more than the width of the labium; considerably longer than the others. Legs relatively long; first pair stoutest. Femoral, tibial and metatarsal spines on the four pairs; on the metatarsi of the fourth throughout their length.

♀. Total length 6.2 mm. Width of abdomen 2.3 mm.

Cephalothorax: length 2; width 1.5; height 8.

Legs 3.5, 2.8, 2.5, 4.3; patella and tibia of the first, 1.3; patella and tibia of the third, 9; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 9.

Middle anterior only twice as large as lateral eyes; lateral not so much separated from middle eyes as in ♂. Falces parallel, fang short and weak. Maxillæ parallel, without projection at outer corner; labium more than once and one-half as long as maxillæ. Anterior coxæ separated by scarcely the width of the labium and not so long as in ♂.

Coloration: ♂. Cephalothorax bronze brown with three longitudinal white bands on each side; the highest of these is much the widest and ex-

tends from the anterior lateral eye to the posterior border; the middle band has its origin on the upper surface of the caput and passing down between the middle and lateral eye of the first row curves backward and extends along the side of the cephalothorax through about half its length; the lowest of the bands is the narrowest; it begins opposite the origin of the palpus, and passes backward just above the lower border, terminating a little beyond the middle band. A wide vertical white band passes between the anterior middle eyes from the upper surface of the caput to the origin of the falces. Abdomen bronze brown, nearly encircled by a white band which extends around the base and sides and ends abruptly just above and in front of the spinnerets. Clypeus, falces, mouthparts and sternum brown; venter brown with three white bands, one on each side, and one connecting these at the apex.

♀. Cephalothorax brown with short white hairs. Abdomen very variable; sometimes pinkish with white bands at base and on the sides, and four pairs of white spots; sometimes brown with many pale spots and curved bands; sometimes brown with four pairs of black spots (resembling *E. octavus*); sometimes bronze with white hairs at base and on the sides, and two longitudinal black bands upon which are three or four pairs of white dots (resembling *P. militaris*). Clypeus white. Other parts varying between light and dark brown.

This species is much like *P. militaris*, but is easily distinguished from it by the difference in size, *P. militaris* being considerably larger. The male sometimes retains the markings of the female, these being proper to it in the immature stage. It was a male of this kind that we described as new under the name of *A. æstivalis*.

Habitat: United States. Mexico.

DENDRYPHANTES ELEGANS Hentz.

Plate III, figures 26, 26a, 26b. Plate IV, figure 26c.

Syn.: 1845. Attus *elegans* H. (♀), Jour. Bost. Soc. Nat. Hist., Vol. V.
1845. " *superciliosus* id. (♂), ibid., Vol. V.
1848. Maevia *cristata* C. K. (♂), Die Arachn., XIV, p. 70.
1875. Attus *elegans* H. (♀), Coll. Arachn. Writ. by N. M. Hentz, Ed. by Burgess, Boston. p. 56.
1875. " *superciliosus* id. (♂), ibid., p. 68.
1883. " *tibialis* Peckham (♂), Descr. new or little known Attidæ of U. S., p. 11.

♂. Total length 4.3 mm. Width of abdomen 1.1 mm.

Cephalothorax: length 1.9; width 1.2; height .8.

Legs 5.4, 3.2, 3.2, 5; patella and tibia of the first, 2; patella and tibia of the third, 1.2; patella and tibia of the fourth, 1.9; metatarsus and tarsus of the fourth, 1.6.

♀. Total length 5.5 mm. Width of abdomen 2 mm.

Cephalothorax: length 2.1; width 1. 2; height 1.

Legs 3.7, 3.1, 3.4, 4.3; patella and tibia of the first, 1.3; patella and tibia of the third, 1.1; patella and tibia of the fourth, 2; metatarsus and tarsus of the fourth, 1.6.

Cephalothorax moderately high, convex, dilated behind dorsal eyes; sides nearly vertical in cephalic, rounded in thoracic part; cephalic part inclined, especially in ♂; thoracic part slanting gradually for the first three-fifths of its length, then steeply. Ocular area occupying about two-fifths of cephalothorax, one-fourth wider than long, slightly wider behind than in front; first row of eyes on a ridge, curved (more in ♂ than in ♀): middle eyes sub-touching; lateral one-half as large as middle eyes, separated from them by one-half their own diameter; eyes of second row halfway between dorsal and lateral eyes; ♂ with two ridges of stout hairs oblique and converging, extending from eyes of second row to anterior middle eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as the cephalothorax at that place. Clypeus vertical, scarcely one-fourth as high as the middle eyes. Falces (♂) extending to inner edges of lateral eyes, (♀) nearly as wide as first row, a little longer than face, parallel, vertical; fang weak; maxillæ parallel, enlarged and (♂) truncated, (♀) rounded at extremity; labium about one-half as long as maxillæ, as wide as long, rounded and much contracted at tip; sternum one and one-half times as long as wide, truncated in front, contracted and rounded behind; anterior coxæ separated (♂) by width of labium, (♀) by less; legs all fine and glabrous, first a little the stoutest; femur of the third long; very weak tibial and metatarsal (and in ♂ femoral) spines on the four pairs; on metatarsi of the third and fourth only in terminal circles.

Coloration: ♂. Cephalothorax black in eye region, reddish on sides and thoracic part, entirely covered with light green iridescent scales, excepting a narrow black line between two white lines around the margin; two whitish tufts of hairs above anterior eyes. Abdomen and venter covered with green iridescent scales. Clypeus iridescent; falces brown; sternum black with white hairs; mouthparts and coxæ brown; palpi and legs light brown, legs with a black longitudinal line above, first and second darker than third and fourth; tibia of the first black at distal end, with a strong black spine and a brush of black hairs. ♀. Cephalothorax dark, covered with iridescent scales, excepting marginal lines as in ♂. Abdomen dark and highly iridescent, with a whitish band around base and anterior sides. Clypeus iridescent; falces, palpi, mouthparts, sternum and coxæ as in ♂. Venter iridescent; legs pale with black lines as in ♂, excepting femur of the first which is dark.

Habiiat: Middle, Eastern and Southern United States.

DENDRYPHANTES FLAVUS Nov. Sp.

Plate I, figure 27. Plate III, figures 27, 27 a.

♀. Total length 6.2 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.7; width 2; height 1.2.

Legs 4.6, 3.5, 3.8, 4; patella and tibia of the first, 2; patella and tibia of the third, 1.6; patella and tibia of the fourth, 1.6; metatarsus and tarsus of the fourth, 1.2.

Cephalothorax not high, convex, dilated at the dorsal eyes, with sides rounded more widely behind than in front; cephalic part inclined. Ocular area occupying a little more than one-third of cephalothorax, one-third wider than long, wider behind than in front; anterior eyes looking downward, in a slightly curved row; middle eyes sub-touching; lateral less than one-half as large as middle eyes, separated from them by one-half their own diameter; eyes of second row a little nearer the lateral than the dorsal eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as the cephalothorax at that place. Clypeus only a line. Falces nearly as wide as first row of eyes, two and one-half times as long as face, a little inclined forward, parallel; fang short. Maxillæ parallel, one-half as long as falces, enlarged and rounded at extremity. Labium a little more than one-half as long as maxillæ, longer than wide, rounded. Sternum deep set, twice as long as wide, truncated in front, rounded behind. Anterior coxæ separated by width of labium; coxæ of the first and second much the stoutest. Legs of the first and second stoutest, with femoral joints compressed, and having a single row of spines above, and several at the extremity; there are femoral, tibial, metatarsal, and sometimes small patellary spines on all the legs; metatarsi of the fourth spined to the base.

Coloration: Cephalothorax covered with yellow hairs, with a transverse brown band at dorsal eyes, and, around the margin, a white line between two black lines. Clypeus covered with white hairs. Abdomen covered by yellow hairs which have a somewhat metallic lustre, and having two longitudinal black bands, on each of which are three white dots. Falces, mouthparts and sternum dark brown, with some white hairs. Coxæ light brown. Palpi covered with gray hairs. Legs brown with gray hairs, and tipped with black. Venter brown with gray hairs.

Habitat: New York.

DENDRYPHANTES MULTICOLOR Hentz.

Plate III, figures 28, 28a.

Syn.: 1844. Attus *multicolor* H., Jour. Bost. Soc. Nat. Hist,. Vol. IV.
1875. " " id., Coll., Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 53.

♀. Total length 6.8 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 3; width 2.5; height 1.5.

Legs 6.1, ——, 4.9, 6.1; patella and tibia of the first, 2.7; patella and tibia of the third, 1.9; patella and tibia of the fourth, 2.2: metatarsus and tarsus of the fourth, 2.1.

Cephalothorax high, convex, a little dilated behind dorsal eyes, with sides rounded more widely behind than in front, cephalic part inclined; thoracic part falling slightly in the first half, and much more steeply in the second. Ocular area occupying nearly one-half the cephalothorax, one-third wider than long, wider behind than in front. First row of eyes on a ridge, slightly curved; middle eyes sub-touching; lateral one-half as large as middle eyes, separated from them by nearly one-half their diameter; second row a little nearer lateral than dorsal eyes; dorsal nearly as large as lateral eyes, further from each other than from lateral borders, forming a row a little narrower than the cephalothorax at that place. Clypeus one-fifth as high as middle eyes, vertical. Falces extending to inner edges of lateral eyes, twice as long as face, vertical, parallel; fang short. Maxillæ parallel, dilated and rounded at extremity. Labium one-half as long as maxillæ, a little longer than wide, contracted and rounded at tip. Sternum nearly twice as long as wide, a little more contracted behind than in front, narrowest in the middle. Anterior coxæ separated by nearly the width of the labium. Legs of the first stoutest, with femoral joints enlarged and compressed. Femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Our single specimen of this species being badly injured, we quote the following description from Hentz:

"Cephalothorax black, with a pale, irregular band each side of the disc; abdomen metallic green, with a band at base, and a diagonal spot each side, orange, and with eight small white spots; underneath obscure gray, with inflections of green on the pectus; feet rufous or pale, varied with piceous $\overline{1.\ 4.}$ $\overline{2.\ 3.}$ This species is related to *A. otiosus* and *mystaceus*, but distinct from both by the absence of the tufts of hair on the cephalothorax, and other characters. The palpi are pale yellow, and there is a black band more or less visible on each side of the abdomen."

Habitat: Pennsylvania, Alabama.

DENDRYPHANTES ALBO-IMMACULATUS Peckham.

Plate III, figure 29.

Syn.: 1883. Attus *albo-immaculatus* P., Descr. new or little known Attidæ of U. S., p. 5.

♀. Total length 5 mm. Width of abdomen 2 mm.

Cephalothorax: length 1.8; width 1.3; height .8.

Legs 3.2, 2.6, 2.4, 3.9; patella and tibia of the first, 1.1; patella and tibia of the third, 8; patella and tibia of the fourth, 1.4; metatarsus and tarsus of the fourth, 1.3.

Cephalothorax rather low, slightly convex, a very little dilated at dorsal eyes, sides almost vertical, posterior margin truncated; cephalic part slightly inclined; ocular area occupying two-fifths of cephalothorax, nearly one-third wider than long, wider behind than in front. Anterior eyes small, in a slightly curved row; middle eyes touching; lateral a little less than one-half as large as middle eyes, separated from them by one-half their own diameter; eyes of second row very small, slightly nearer the lateral than the dorsal eyes; dorsal a little larger than lateral eyes, further from each other than from lateral borders, forming a row as wide as the cephalothorax at that place. Clypeus vertical, one-third as high as middle eyes. Falces as wide as first row of eyes, twice as long as face, vertical, parallel; fang short. Maxillæ parallel, long, enlarged and rounded at extremity; labium one-fourth longer than wide, one-half as long as maxillæ, contracted and rounded at tip. Sternum twice as long as wide, contracted and truncated in front. Anterior coxæ separated by nearly the width of the labium. Femur, patella and tibia — especially tibia — of the first enlarged; femur with a row of short and strong black hairs near the middle of the lower border; patella with two circles of white hair separated by a hairless median part; the tibia has, on the upper border, a short ridge of strong black hairs, and on the lower border a longer ridge, the hairs below being as long as the articulation is thick; metatarsus and tarsus slender. Weak femoral, tibial and metatarsal spines on the four pairs, on the metatarsi of the third and fourth only in terminal circles.

Coloration: Cephalothorax and abdomen closely covered with short white hairs, with a few, scattered, long black hairs; clypeus, falces, palpi, sternum, coxæ and venter covered with white hairs; mouth-parts pale; first leg brown, excepting the tibia, which is black; other legs light brown with longitudinal lines of white hairs.

Habitat: Iowa, New York.

DENDRYPHANTES FLAVIPEDES Nov. Sp.

Plate III, figure 29a.

♂. Total length 4.6 mm. Width of abdomen 2 mm.

Cephalothorax: length 2; width 1.4; height 1.

Legs 4, 3, 2. 8, 3. 4; patella and tibia of the first, 1.5; patella and tibia of the third, 1; patella and tibia of the fourth, 1.4; metatarsus and tarsus of the fourth, 1.

Cephalothorax moderately high, slightly convex; a little dilated behind dorsal eyes, with sides nearly vertical in front and rounded behind; cephalic part a little inclined forward; thoracic part falling a very little in the first half, then more steeply. Quadrangle of eyes occupying two-fifths of cephalothorax, one-quarter wider than long, an a little wider behind than in front. First row of eyes bent; middl eyes sub-touching; lateral more than one-half as large as middl eyes, and separated from them by one-fourth their own diameter. Eyes of second row half way between lateral and dorsal eyes. Dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus vertical, one-third as high as middle eyes. Falces as wide as the two middle eyes, once and a half as long as face, vertical, parallel; fang weak. Maxillæ blunt, cut on inner margins toward labium. Labium a little longer than wide, less than one-half as long as maxillæ. Sternum oval, one-third longer than wide, projecting between anterior coxæ. Anterior coxæ separated by width of labium, stouter and longer than the others. Legs of the first pair much the stoutest and longest, with femoral joints compressed and enlarged. Femoral, tibial and metatarsal spines on the four pairs, only in terminal circles on metatarsi of the third and fourth.

Coloration: Cephalothorax dark brown, with the eyes on a black band, a black line around the lower margin, and some white hairs on the sides. Abdomen dark brown with six impressed dots on the anterior, and several darker chevrons on the posterior part. Legs light brown, tipped with black, and having a black line along the anterior faces of the femur, patella and tibia of the first and second. Palpi light brown, excepting the tarsus, which is black. Face, falces, mouthparts and coxæ, light brown; sternum and venter a little darker.

Habitat: Canada.

ATTUS PALUSTRIS Peckham.

Plate I, figure 30. Plate III, figures 30, 30a.

Syn.: 1883. Attus *palustris* P., Descr. new or little known Attidæ of U. S., p. 25.

♂. Total length 5 mm. Width of abdomen 2 mm.

Cephalothorax: length 2.7; width 1.6; height 1.

Legs 4.6, 3.6, 3.4, 4.4; patella and tibia of the first, 1.9; patella and tibia of the third, .9; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 1.3.

♀. Total length 5.3 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 2.1; width 1.8; height 1.2.

Legs 3, 2.7, 2.5, 4.2; patella and tibia of the first, 1.1; patella and tibia of the third, .9; patella and tibia of the fourth, 1.5; metatarsus and tarsus of the fourth, 1.4.

Cephalothorax moderately high, and convex, very slightly dilated behind dorsal eyes, with sides nearly vertical in front, rounded behind; cephalic part inclined; thoracic part falls gradually in the first half, then steeply. Ocular area occupying two-fifths of cephalothorax, nearly twice as wide as long, a little wider behind than in front. Anterior eyes on a ridge, in a straight row; middle eyes touching; lateral one-half as large as middle eyes, separated from them by one-half their own diameter; eyes of second row slightly nearer lateral than dorsal eyes; dorsal a little smaller than lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus one-half as high as middle eyes, inclined backward. Falces extending to inner edges of lateral eyes, twice as long as face, flat, vertical, divergent; fang weak. Maxillæ parallel, short, enlarged and rounded at extremity. Labium a little more than one-half as long as maxillæ, as wide as long, (♀) rounded, (♂) more pointed. Sternum oval, not one-half longer than wide. Anterior coxæ separated by more than width of labium. Legs of the first pair a little stoutest; femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: ♂. Cephalothorax dark brown, reddish toward eyes, nearly black behind; three white lines begin at the posterior end and run forward: the median line ends before reaching the anterior eyes; the lateral lines pass just outside the dorsal eyes and inside the small median eyes, and are connected by a transverse white line which crosses the eye region just above the anterior eyes; there is sometimes a less distinct white line behind the dorsal eyes, which, with the median longitudinal line, forms a white cross; the margin has a narrow line of white hairs which appear to be combed upward. Clypeus brown

except a white line just under the eyes, and a fringe of white hairs. Abdomen with a narrow central longitudinal brown band, on either side of which the dorsum is black; in the center of the dorsum are two transverse white bars or large spots, one on each side, in front of which are one or two dots on each side, while behind them, in the middle line are two indistinct light dots, one behind the other; just above the apex are two white bars corresponding to the middle bars but narrower; the lower sides are light brown or gray, and the base is sometimes whitish. Falces, mouthparts and coxæ dark brown. Sternum black. Venter gray with two longitudinal brown bands. Palpi and legs dark brown. ♀. Cephalothorax gray with a white cross behind dorsal eyes and a white band low on each side. Clypeus covered with white hairs. Abdomen gray at base, white at apex; near the base and close together are two large black spots, in the middle of each of which is a white dot; continuous with these spots are two narrow black bands, which curve outward and then inward, enlarging into two posterior spots, which are joined in the middle by a short black band which curves forward; the central region thus enclosed is white with a dark spot in the middle; behind, in the middle line and decreasing in size as they approach the apex, are several short transverse black bands. These markings are somewhat variable but the species is easily distinguished. Palpus pale with white hairs. Legs light brown with dark rings. Otherwise like ♂.

Habitat: Wisconsin, Michigan.

ATTUS IMPERIALIS Nov. Sp.

Plate III, figures 31, 31a.

♂. Total length 4 mm. Width of abdomen 2 mm.

Cephalothorax: length 2; width 1.7; height 1.2.

Legs 4.8, 3.1, 2.8, 4.2; patella and tibia of the first, 2; patella and tibia of the third, 9; patella and tibia of the fourth, 1.6; metatarsus and tarsus of the fourth, 1.3.

Cephalothorax moderately high, slightly convex, a little dilated behind dorsal eyes, with sides nearly vertical; cephalic part slightly inclined; thoracic part slanting gradually in the first two-thirds, then abruptly. Ocular area occupying a little less than one-half cephalothorax, one-third wider than long, wider behind than in front. First row of eyes very slightly curved; middle eyes sub-touching; lateral rather more than one-half as large as middle eyes, separated from them by two-thirds their own diameter; eyes of second row very slightly nearer lateral than dorsal eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as the cephalothorax at that place. Clypeus one-fourth

as high as middle eyes, vertical; falces extending to inner edges of lateral eyes, as long as face, vertical, divergent; fang short, rather stout. Maxillæ parallel, enlarged and truncated at extremity, with projection on outer corner. Labium scarcely one-half as long as maxillæ, but little longer than wide, contracted at tip. Sternum less than one-half longer than wide, truncated in front, narrow behind. Anterior coxæ separated by more than width of labium. Legs, first and second stoutest, with femoral joints enlarged and compressed. Femoral, tibial and metatarsal spines on the four pairs; femoral spines weak; tibial and metatarsal spines of the first and second in two inferior rows, on the third and fourth very weak; on the metatarsi irregularly on the body of the articulation as well as in terminal circles.

Coloration: Cephalothorax dark reddish brown with a white band on each upper side, and, on the face, two snowy white bands which begin on each side between the middle and lateral eye and extend obliquely downward and backward to the cephalic margin. Parallel with these are two equally wide and white bands which cover the anterior faces of the falces. These bands make the appearance of the spider from in front very striking and characteristic. Abdomen reddish brown in the middle, with a longitudinal black band on each side; on each of these bands, near the apex, is a white dot, and below, the sides and base are encircled by a white band. Palpus brown with a ring of white hairs at the distal end of the femur. Mouthparts, sternum and venter dark brown. Coxæ light brown. Legs dark brown with femoral joints nearly black.

Habitat: California.

ICIUS LINEATUS C. K.

Plate I, figure 32. Plate III, figures 32, 32 a., 32 b.

Syn: 1848. Mævia *lineata* C. K., Die Arachn., XIV, p. 77.
1883. Attus *quadrilineatus* Peckham, Descr. new or little known Attidæ of U. S., p. 19.

♀. Total length 5.3 mm. Width of abdomen 2 mm.

Cephalothorax: length 2; width 1.5; height 8.

Legs 3.4, 2.4, 2.2, 3.9: patella and tibia of the first, 1.6; patella and tibia of the third, 8; patellia and tibia of the fourth, 1.5; metatarsus and tarsus of the fourth, 1.2.

Cephalothorax low, flat, a very little dilated behind dorsal eyes, with sides nearly vertical in front, rounded behind; cephalic part inclined; thoracic part falling slightly in first half, then more steeply. Ocular area occupying two-fifths of cephalothorax, one-fourth wider than long, very slightly wider behind. First eyes sub-touching, in a straight

row, all small, projecting, lateral about one-half as large as middle eyes; eyes of second row a little nearer the dorsal than the lateral eyes; dorsal a little smaller than lateral eyes, further from each other than from lateral borders, in a row as wide as the cephalothorax at that place. Clypeus one-fourth as high as middle eyes, vertical. Falces but little wider than the two middle eyes, a little longer than the face, vertical, parallel; fang very weak, maxillæ parallel, a little enlarged and blunt at extremity. Labium one-third as long as maxillæ, as wide as long, truncated. Sternum pointed in front and behind, nearly as wide as long. Anterior coxæ separated by a little less than width of labium. Legs of the first pair stoutest; femoral, tibial and metatarsal spines on the four pairs, metatarsi of the third and fourth with only terminal circles.

Coloration: Eye region black covered with yellowish hair, thoracic region testaceous with sparse yellow hair, lower margin black; abdomen (dry) blackish, with some yellow hairs; four slender lines of white hairs begin at the base; the two middle lines start from the same point; and separating a little pass out on each side of the middle to the spinnerets; the lateral lines extend along the sides from base to apex, and are not visible from above. Clypeus covered with white hairs; falces, mouthparts, sternum and coxæ all brown; palpi pale; legs brown, first pair darkest with black hairs; venter pale with irregular, dark, longitudinal lines.

Habitat: Pennnsylvania, Wisconsin, Georgia (Gentry Coll).

ICIUS PALMARUM Hentz.

Plate I, figure 3a. Plate III, figures 33, 33a.

Sym.: 1832. Epiblemum *palmarum* H., Am. Jour. Sci. and Arts, art. 21, p. 108.
1845. " " id., Journal Bost. Soc. Nat. Hist., vol. V.
1875. " " id., Coll. Arachn. Writ. by N. M. Hintz, ed. by Burgess, Bost., p.71.
1883. " " Peckham, Descr. new or little known Attidæ of U. S., p. 28.

♂. Total length 5.5 mm. Width of abdomen 1.1 mm.

Cephalothorax: length 2.1; width 1.8; height 1.

Legs 6.1, 4.2, 3.5, 4.2; patella and tibia of the first, 2.9; patella and tibia of the third, 1.4; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 1.2.

♀. Total length 1.6 mm. Width of abdomen 1.2 mm.

Cephalothorax: length 1.6; width 1.4; height 8.

Legs 4.5, 2.7, 2.8, 3.5; patella and tibia of the first, 1.5; patella and tibia of the third, 1; patella and tibia of the fourth, 1.3; metatarsus and tarsus of the fourth, 1.

Cephalothorax moderately high, nearly plane, a very little dilated behind dorsal eyes, with sides nearly vertical in front and rounded behind; cephalic part very slightly inclined; thoracic part with the first half falling gradually and the second steeply. Ocular area occupying (♂) two fifths, (♀) less than two-fifths of cephalothorax, one-third wider than long, wider behind than in front. First row of eyes straight; middle eyes sub-touching; lateral one-half as large as middle eyes, and a little separated from them; eyes of second row a little nearer lateral than dorsal eyes; dorsal a little smaller than lateral eyes, further from each other than from lateral border, forming a row which is narrower than the cephalothorax at that place. Clypeus a little more than one-fourth as high as middle eyes. Falces compressed, parallel, extending to inner edges of lateral eyes, (♂) three times as long as face, horizontal, (♀) as long as face, vertical; fang (♂) as long as falx, (♀) short. Maxillæ long, enlarged at extremity, (♂) with projection at outer corner, and excavated for labium; (♀) rounded, not excavated. Labium two-thirds as long as maxillæ, nearly twice as long as wide, contracted and rounded at tip. Sternum oval, one-half longer than wide, scarcely projecting between anterior coxæ. Anterior coxæ separated by scarcely the width of the labium. Legs of the first pair much the longest and stoutest, especially in ♂, with femoral joints enlarged and compressed in both sexes; femoral, tibial and metatarsal spines on the four pairs, on metatarsi of the third and fourth, only in terminal circles.

Coloration: ♂. Cephalothorax bronze-brown, with short golden down, lighter in eye region; lower margin black; a wide white band passes around the clypeus and upper sides, just below the eyes, and just behind the dorsal eye, on each side, curves upward over the thorax, ending near the posterior margin; the eyes are surrounded with bright red hair. Abdomen bronze-brown, covered with golden down; there are white bands on the sides from base to apex, which do not meet at base, where there is a tuft of black hairs. Clypeus covered with long, snowy white hairs; falces dark rufus, with lines of white hairs on their outer edges; mouthparts almost black; sternum rufus; palpi and legs of the first pair (including coxæ) dark rufus; legs of the second, third and fourth (including coxæ), pale, tipped with black. Venter, rufus, edged with white. ♀. Cephalothorax, rufus, covered with white hairs, with lower margin black; there are two dark spots in the eye region, behind the middle anterior eyes, and some long black hairs outside the lateral eyes. Abdomen pale, covered with white hairs, and having a tuft of white hairs at base; there is a central, longitudinal, branching, rufus band, made up of many dots,

spots and lines, which is indistinctly visible through the white hairs. Clypeus with white hairs; falces, dark rufus; palpus, pale with three rufus bars, mouthparts very dark, sternum and coxæ, light rufus; legs of the first pair light rufus, the others pale, tipped with black. Venter covered with white hairs.

Habitat: New York, North Carolina, South Carolina, Alabama, Florida.

ICIUS MITRATUS Hentz.

Plate I, figure 34. Plate III, figure 34a. Plate IV, figure 34.

Syn.: 1845. Attus *mitratus* (♂) H., Journal Bost. Soc. Nat. Hist., Vol. V.
1845. " *morigerus* (♀) id., ibid.
? 1848. Mævia *pallida*, C. K., Die Arachn, XIV, p. 79.
1875. Attus *mitratus* H., Coll. Arachn. Writings by N. M. Hentz ed. by Burgess, Boston, p. 68.
1875. " *morigerus* id., ibid., p. 69.

♂. Total length 4.7 mm. Width of abdomen 1 mm.

Cephalothorax: length 1.9; width 1.3; height .7.

Legs 5.6, 3.5, 3.2, 4; patella and tibia of the first, 2.2; patella and tibia of the third, 1.2; patella and tibia of the fourth, 1.6; metatarsus and tarsus of the fourth, 1.6.

♀. Total length 5 mm. Width of abdomen 1.5 mm.

Cephalothorax: length 2; width 1.4; height .8.

Legs 3.2, 3, 2.2, 3; patella and tibia of the first, 1.5; patella and tibia of the third, .9; patella and tibia of the fourth, 1.4; metatarsus and tarsus of the fourth, 1.4.

Cephalothorax rather low, slightly convex, a little dilated behind dorsal eyes, with sides nearly vertical in front, and rounded behind; cephalic part inclined; thoracic part falling gradually in the first half, then steeply. Ocular area occupying about two-fifths of cephalothorax, one-third wider than long, slightly wider behind than in front. First row of eyes straight; middle eyes sub-touching; lateral about one-half as large as middle eyes, separated from them by one-fourth their own diameter; eyes of second row half way between lateral and dorsal eyes; dorsal not quite so large as lateral eyes, further from each other than from lateral borders, forming a row slightly narrower than the cephalothorax at that place. Clypeus vertical, one-half as high as middle eyes. Falces a little wider than middle eyes, slightly longer than face, parallel, vertical; fang small. Maxillæ long, rounded and a little enlarged at the extremity; labium twice as long as wide, two thirds as long as maxillæ, a little rounded at tip, mouthparts longer and narrower in ♂ than in ♀. Sternum contracted in front, rounded behind, (♂) nearly twice as long as wide

(♀) one-half longer than wide. Anterior coxæ separated (♂) by width of labium, (♀) by scarcely so much. Legs of the first pair stoutest, and in ♂ very long. Femoral, tibial and metatarsal spines on the four pairs, on metatarsi of the third and fourth only in terminal circles.

Coloration: Cephalothorax reddish, covered with silvery down; eyes on black spots, a black line around margin, and (♀) two or three stout black hairs on each side below the eyes of the second row. Abdomen (♂) covered with white down with an encircling white band, and three, short, transverse dark bars on the dorsum; (♀) covered with down as in ♂, with three pairs of dark spots. Clypeus covered with white hairs which extend downward over the reddish falces. Mouthparts and sternum reddish brown. Coxæ pale; palpi and legs pale tipped with black. Venter covered with silvery down.

Habitat: Wisconsin, Pennsylvania, North Carolina, Alabama, Georgia, Florida.

ICIUS PIRATICUS Nov. Sp.

Plate I, figure 35. Plate IV, figures 35, 35a.

♂. Total length 7 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 3.9; width 2; height 1.3.

Legs 5.9, 3.5, 4.9, 5.2; patella and tibia of the first, 2.5; patella and tibia of the third, 1.8; patella and tibia of the fourth, 1.8; metatarsus and tarsus of the fourth, 1.6.

Cephalothorax low, flat, narrow in front, dilated behind dorsal eyes, with sides nearly vertical in front and rounded behind; cephalic part plane, slightly inclined; thoracic falling a very little in the first half, then more steeply. First row of eyes straight; middle eyes touching, lateral sub-touching, one-half as large, and placed plainly further back; eyes of second row a little nearer lateral than dorsal eyes, and very small; dorsal a little smaller than lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Whole ocular area occupying a little more than one-third of cephalothorax, one-third wider than long, wider behind than in front. Clypeus inclined backward, one-half as high as middle eyes. Falces but little wider than the two middle eyes, one-fourth longer than face, vertical, parallel; fang very weak. Maxillæ long, parallel, a little enlarged and rounded at extremity. Labium two-thirds as long as maxillæ, twice as long as wide. Sternum not projecting between anterior coxæ, a little longer than wide, rounded. Anterior coxæ square, nearly touching. First leg with femur and tibia exceedingly stout, and metatarsus and tarsus very short; the other legs weak. Spinal armature as follows: Tibia of the

first, one short inferior spine; metatarsus of the first, two stout inferior spines; metatarsus of the second, two inferior not very stout spines; metatarsi of the third and fourth with only terminal circles.

Coloration: Cephalothorax with the entire upper surface covered with short white hairs, black on the sides, and white on the lower border; anterior middle eyes surrounded by reddish rings. Clypeus covered with short white and reddish hairs. Abdomen black with a wide central longitudinal white band, and the lower sides white. Falces black, with some short white hairs. Mouthparts black. Coxæ brown. Sternum black with white hairs. Venter covered with white hairs. Palpi brown with white hairs. Legs of the first pair black, and of the second, third and fourth, brown, all with white hairs which form heavy fringes on the undersides of the first legs.

Habitat: Texas.

ICIUS ALBOVITTATUS Keyserling.

Plate 1, figure 35a. Plate 4, figure 35d.

Syn.: 1885. Wala *albovittata* Keys., Neue Spinnen aus Amerika. VI, Verhandl. zool. bot. gesel. in Wien, p. 31 (517).

♂. Total length 5.2 mm. Width of abdomen 1.3 mm.

Cephalothorax: length 1.9; width 1.7.

Legs 6.4, 3.7, 3.5, 4.1; patella and tibia of the first, 2.7; patella and tibia of the third, 1.3; patella and tibia of the fourth 1.6; metatarsus and tarsus of the fourth, 1.3.

Cephalothorax low and flat, plainly wider in the middle, with rounded sides; cephalic part inclined forward. Quadrangle of eyes occupying almost one-half of the cephalothorax, a little more than one-third wider than long, wider behind than in front. First row of eyes a little bent. Middle eyes nearly touching; lateral one-half as large and separated from them by one-third their own diameter. Second row of eyes plainly nearer the first than the third row. Dorsal eyes as large as the lateral, further from each other than from the lateral borders, forming a row not quite so wide as cephalothorax at that place. Clypeus extremely low. Falces nearly as wide as first row of eyes, compressed from before behind, wider in middle than at base or extremity, a little inclined forward, diverging at the extremities; fang two-thirds as long as falx. Maxillæ slightly diverging, rather long, enlarged and truncated at extremity. Labium two-thirds as long as maxillæ, longer than wide, a little widest in middle, truncated. Sternum rounded, nearly as wide as long, projecting a very little between anterior coxæ. Anterior coxæ separated by less than width of labium. First legs much the longest and stoutest. Femoral and metatarsal spines on the four pairs, only in terminal circles on the third and fourth; tibial spines on the first and second.

Coloration: Cephalothorax red-brown covered above and on the upper sides with white hairs; lower sides brown; eyes and lower margin black; clypeus white; looked at from in front a dark line extends from each middle and from each lateral eye, backward and downward to the margin. Abdomen bronze brown encircled by a white band, below which is a dark brown band; lower sides brown: falces, mouthparts, sternum, coxæ and legs of first pair dark red-brown, excepting the proximal end of the metatarsus, and the tarsus which are yellow. The other coxæ and legs yellow tipped with black. Venter yellowish brown.

Habitat: North America.

PSEUDICIUS HARFORDII Nov. Sp.

Plate I, figures 36, 36a. Plate III, figure 36. Plate IV, figure 36a.

♂. Total length 6.3 mm. Width of abdomen 2.1 mm.

Cephalothorax: length 3; width 2.4; height 2.

Legs 6.1, 5.6, 5.3, 5.9; patella and tibia of the first, 2.6; patella and tibia of the third, 2.2; patella and tibia of the fourth, 2.5; metatarsus and tarsus of the fourth, 1.6.

♀. Total length 6.9 mm. Width of abdomen 2.7 mm.

Cephalothorax: length 3; width 2.4; height 1.7.

Legs 5.4, 7, 4.8, 5.6; patella and tibia of the first, 2.4; patella and tibia of the third, 2.2; patella and tibia of the fourth, 2.2; metatarsus and tarsus of the fourth, 1.8.

Cephalothorax moderately high, slightly convex, a little dilated in the middle, sides vertical in front, rounded behind; cephalic part inclined. Ocular area occupying two-fifths of the cephalothorax, one-fourth wider than long, equally wide in front and behind. Anterior eyes all small, in a straight row; middle eyes sub-touching; lateral one-half as large as middle eyes and scarcely separated from them; eyes of second row nearer lateral than dorsal eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row not so wide as the cephalothorax at that place. Clypeus one-fourth as high as middle eyes, vertical. Falces wider than the two middle eyes, a little longer than the face, vertical, parallel; fang one-half as long as falx. Maxillæ narrow at base, enlarged at extremity, (♂) with point at outer corner, (♀) rounded, parallel. Labium oval (♂) one-half (♀) nearly two-thirds as long as maxillæ. Sternum contracted in front, one-third longer than wide. Anterior coxæ separated (♂) by more, (♀) by less than width of labium. Legs of the first and second pairs stoutest: femoral, tibial and metatarsal spines on the four pairs: stout and regular in two rows on tibiæ and metatarsi of the first and second, less stout and regular on third and fourth; metatarsi of the fourth spined throughout their length.

Coloration. ♂. Cephalothorax light brown; a band of white hairs comes up from between the middle anterior eyes and joins a white spot which is found on the posterior cephalic part; on each upper side is a wide band of white hairs which extends from the anterior lateral eye, surrounding the dorsal eye, to the posterior margin; there is a white line around the lower margin; the entire face is covered with thick snowy white hairs, which grow from the sides toward the middle, surrounding the anterior eyes and growing downward on to the upper part of the falces; just behind and below the anterior lateral eyes are some small scattering tufts of black hairs. Abdomen light golden brown, encircled by a wide band of white hairs. Falces (excepting the white hairs at the upper edge) and mouthparts dark reddish brown. Sternum, coxæ and venter light brown. Legs all light brown excepting the last three joints of the first pair which are dark reddish brown; all the legs tipped with black. ♀. Cephalothorax light brown covered with short white hairs, which are easily rubbed off, but usually show a white band coming up from between the middle anterior eyes. Abdomen covered with gray hairs and fine red dots. Venter covered with gray hairs. Mouthparts pale. Legs pale (excepting first pair which is light brown) all tipped with black. Face and other parts as in male. In some cases the male retains the coloration of the female.

This species bears a strong general resemblance to Icius albo-vittatus Keys.

Habitat: California.

SADALA Nov. Gen.

Cephalothorax rather low and nearly flat, contracted slightly in front and behind, one-fourth longer than wide, and a very little wider than the third row of eyes. Cephalic part occupies two-fifths of the cephalothorax; the thoracic part begins to slant near its posterior border, and is rounded behind. Quadrangle of eyes nearly twice as wide as long, and equally wide in front and behind. First row of eyes nearly straight, middle very nearly touching, and three times as large as the lateral, from which they are just separated. Second row of eyes small and plainly nearer (two-fifths) the anterior lateral. Dorsal eyes as large as lateral, and much further from each other than from the lateral borders. Clypeus very low (one-fifth to one-eighth the height of anterior middle eyes). Sternum oval, a little longer than wide, projecting between the coxæ of the first pair, which are separated by the width of the labium. Labium less than half as long as the maxillæ, and as wide as long. Falces short (as long as the face) but little longer than wide. Legs 1, 4, 2, 3. First stoutest, second next. The patella with tibia of the third shorter than patella with tibia of the

fourth. Metatarsus with tarsus of the fourth shorter than patella with tibia. Femoral, tibial and metatarsal spines on the four pairs. Metatarsi of the fourth spined to the base. Abdomen long and slender.

Sadala is near *Icius* E. S., but differs in having the quadrangle of eyes nearly twice as wide as long; middle eyes three times as large as the anterior lateral; quadrangle of eyes equally wide in front and behind; legs 1, 4, 2, 3; metatarsi of the third and fourth spined throughout their length.

SADALA DISTINCTA Nov. Sp.

Plate I, figure 70. Plate VI, figures 76, 76a.

♂. Total length 5.3 mm. Width of abdomen 1.1 mm.

Cephalothorax: length 2; width 1.5; height 6.

Legs 4.6, 3.6, 3.1, 3.9; patella and tibia of the first, 2.2; patella and tibia of the third, 1; patella and tibia of the fourth, 1.6; metatarsus and tarsus of the fourth, 1.2.

Cephalothorax not high, slightly convex, contracted in front and behind, with sides rounded, more widely behind than in front; cephalic part plane, not inclined; thoracic part with first three-fifths level. Ocular area occupying two-fifths of cephalothorax, one-third wider than long, very slightly wider in front than behind. First row of eyes nearly straight; middle eyes prominent, touching; lateral only one-third as large as middle eyes, and slightly separated from them; eyes of second row very small, a little nearer lateral than dorsal eyes; dorsal as large as lateral eyes, much further from each other than from lateral borders, forming a row very nearly as wide as cephalothorax at that place. Clypeus retreating, one-eighth as high as middle eyes. Falces as wide as the two middle eyes, scarcely longer than face, length and width about equal, parallel, slightly inclined backward; fang very small. Maxillæ enlarged and truncated at extremity, parallel. Labium one-half as long as maxillæ, as wide as long, rounded. Sternum oval, about twice as long as wide. Anterior coxæ separated by width of labium. Legs of the first pair stoutest, second next; these two pairs with femoral joints compressed; femoral tibial and metatarsal spines on the four pairs; metatarsi of the fourth, armed throughout their length. Palpus with a tibial apophysis.

Coloration: Cephalothorax clear light-reddish brown; a black band includes the first and second rows of eyes; the dorsal eyes are placed upon black spots, and there are two dark spots on the posterior cephalic part; on each side a white line extends from the lateral eyes on to the anterior thoracic part, passing below the small median and the

dorsal eye; near the termination of this line, at the point at which the thoracic part begins to slant downward, there arises a slightly oblique white line which passes downward to the border. The lower margin is dark brown. Clypeus brown. The lower anterior face of the abdomen is black; above this is a curved white band which ends, on each side, in an oblique bar. The anterior dorsum is umber brown; in front of the middle are two black spots, separated by a line of brown; a little behind these is one large black spot which is surrounded by white. There is a second pair of oblique white bars, on the sides, at this point of the abdomen. The posterior end of the abdomen is white, with one or two transverse bands of light brown. The entire dorsum is sparsely covered with long yellowish hairs. Falces black. Mouthparts, palpi, and coxæ of the first and second, brown; coxæ of the third and fourth, pale, each with a black spot. Sternum black. Legs of the first and second, dark brown; of the third, femur dark brown, other joints lighter; of the fourth, light-brown or pale; patella and tibia of the third and fourth, with black lines on both anterior and posterior faces. Venter black.

Habitat: Mexico.

ERIS OCTAVUS Hentz.

Plate I, figure 37, Plate III, figure 37.

Syn.: 1845. Attus *octavus* H., Journal Bost. Soc. Nat. Hist., Vol. V.
1875. Attus *octavus* id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 70.

♀. Total length 4.2 mm.

Cephalothorax: length 1.8; width 1.5; height 1.

Legs 4.2, 3, 3, 3.9; patella and tibia of the first, 1.5; patella and tibia of the third, 1.2; patella and tibia of the fourth, 1.4; metatarsus and tarsus of the fourth, 1.1.

Cephalothorax a little wider at the dorsal eyes, with sides nearly vertical in front, rounded in the thoracic part, and truncated behind. Ocular area one-fourth wider than long, wider behind than in front; anterior row of eyes straight; lateral more than one-half middle eyes, separated from them by one-half their own diameter; eyes of second row half way between lateral and dorsal eyes; dorsal eyes further from each other than from lateral borders. Clypeus one-fifth as high as middle eyes. Falces extending in width to inner edges of lateral eyes, as long as face, parallel, vertical. Maxillæ rather long, a little enlarged and rounded at tip, parallel; labium one-half as long as maxillæ, as wide as long, contracted and rounded at tip. Sternum one-half longer than wide, narrow at both ends, truncated in

front. Anterior coxæ separated by scarcely the width of the labium. First pair of legs stoutest. Femoral, tibial and metatarsal spines on the four pairs; the metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax and abdomen light rufus, brown, or yellowish, covered with short white hairs; cephalothorax with the eyes on black spots; abdomen with four pairs of black spots on the posterior part, in two converging longitudial lines; all the other parts light brown with short white hairs, the legs being tipped with black.

Habitat: New York, Alabama, North Carolina, Georgia.

ERIS (?) BARBIPES Nov. Sp.

Plate IV, figures 38, 38a.

♀. Total length 6.8 mm. Width of abdomen 2.7 mm.

Cephalothorax: length, 2.4; width, 1.9; height 1.2.

Legs 4.8, 3.6, 4.5, 5.3; patella and tibia of the first, 2.1; patella and tibia of the third, 1.7; patella and tibia of the fourth, 2.3; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax moderately high, slightly convex, very slightly dilated in the middle, with sides nearly vertical; cephalic part a little inclined; thoracic part falling gradually in the first two-thirds, then steeply. Ocular area occupying one-half cephalothorax, one-third wider than long, plainly wider behind than in front. Anterior eyes all subtouching, in a straight row; middle twice as large as lateral eyes; eyes of second row nearly twice as far from dorsal as from lateral eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus vertical, one-fourth as high as middle eyes. Falces nearly as wide as first row of eyes, twice as long as face, vertical, parallel; fang short. Maxillæ rather long, parallel, enlarged and rounded at extremity. Labium more than one-half as long as maxillae, twice as long as wide, pointed at tip. Sternum about twice as long as wide, slightly contracted in front and behind. Anterior coxæ separated by less than width of labium. Legs of the first pair much stoutest; tibia especially enlarged with fringe of hairs; third and fourth slender; femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax black, with cephalic and anterior thoracic parts covered with short greenish hairs, and a white band around lower margin. Abdomen black with white basal band, covered with short scalelike slightly iridescent greenish hairs. Clypeus, falces,

mouthparts and sternum black. Coxæ dark brown. Venter covered with hairs as above. Palpi light, covered with short white hairs. Legs of the first pair black, excepting metatarsi and tarsi which are light brown; other legs brown, lighter toward extremities, with some short white hairs.

Habitat: Mexico.

ERIS NERVOSUS Nov. Sp.

Plate I, figure 39. Plate III, figure 39.

♀. Total length 4 mm. Width of abdomen 1.5 mm.

Cephalothorax: length 1.6; width 1.4; height .7.

Legs 4, 3.2, 2.9, 3.7; patella and tibia of the first, 1.3; patella and tibia of the third, .9; patella and tibia of the fourth, 1.3; metatarsus and tarsus of the fourth, 1.

Cephalothorax not high, nearly plane, a little dilated opposite dorsal eyes, with sides nearly vertical in front, and somewhat rounded behind; cephalic part very little inclined; thoracic part sloping from just behind dorsal eyes. Ocular area occupying nearly three-fifths of cephalothorax, one fourth wider than long, wider behind than in front. Anterior eyes small, in a straight row, slightly separated from each other; middle scarcely twice as large as lateral; eyes of second row twice as far from dorsal as from lateral eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus one-half as high as middle eyes, a little inclined backwards. Falces extending to inner edges of lateral eyes, a little longer than the face, nearly square, parallel, a little inclined backward, fang weak. Maxillæ diverging a little, enlarged and rounded at extremity. Labium one-half as long as maxillæ, a little longer than wide, rounded. Sternum nearly round. Anterior coxæ separated by scarcely the width of the labium. Legs of the first pair stoutest, with femoral joints enlarged and compressed, and patella and tibia much stouter than metatarsus and tarsus; weak femoral spines on first, second and third; stout tibial and metatarsal spines on the first, and weak spines on the corresponding joints of the second.

Coloration: Cephalothorax black. Clypeus black with a few long white hairs. Abdomen dark reddish brown with some very short white hairs, three rather indistinct, oblique black bands on each side of dorsum, and two white chevrons at apex. Falces and mouthparts dark brown. Sternum and coxæ light brown. Venter dark reddish brown with short gray hairs. Palpi and legs light brown, the legs tipped with black.

Habitat: New York.

HASARIUS HOYI Peckham.

Plate I, figures 40, 40a. Plate IV, figure 40, 40a.

Syn.: 1883. Attus *hoyi* (♂) P., Descrip. of new or little known Attidæ, p.7.

1883 " *pinus* (♀) id., ibid., p. 20.

♂ Total length 5.2 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.3; width 1.9; height 1.6.

Legs 5.2, 4, 5.2, 4.9; patella and tibia of the first, 2; patella and tibia of the third, 1.7; patella and tibia of the fourth, 1.9; metatarsus and tarsus of the fourth, 1.6.

♀ Total length 5.9 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 2.5; width 2; height 1.7.

Legs 4.6, 4.2, 5, 4.8; patella and tibia of the first, 2.2; patella and tibia of the third, 1.9; patella and tibia of the fourth, 2.1; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax rather high, plane, slightly dilated behind dorsal eyes, with sides nearly vertical in front, rounded behind; cephalic part inclined (more strongly in ♂ than in ♀); thoracic part falling but little in the first two-thirds, then steeply. Ocular area occupying two-fifths of cephalothorax, one-third wider than long, and almost imperceptibly wider in front than behind. First row of eyes straight; middle eyes sub-touching; lateral more than one-half as large as middle eyes, separated from them by by one-third their own diameter; eyes of second row half way between dorsal and lateral eyes; dorsal a little smaller than lateral eyes, further from each other than from lateral borders, forming a row scarcely narrower than the cephalothorax at that place. Clypeus (♂) vertical, one-third, (♀) inclined, one-fifth as high as middle eyes. Falces extending to the inner edges of lateral eyes, but little longer than face, vertical, parallel; fang weak. Maxillæ parallel, short, slightly enlarged and rounded at extremity; labium one-half as long as maxillæ, but little longer than wide, a little contracted and blunt at tip. Sternum oval, one-half longer than wide. Anterior coxæ separated by width of labium. Legs of the first and second pairs stoutest; third longer than fourth by greater length of femur, femoral, tibial and metatarsal spines on the four pairs; on metatarsi of the fourth throughout their length.

Coloration: ♂. Ocular and anterior thoracic region rufus a little mixed with black; posterior thoracic region black; a white band on each side, beginning at or near the base passes forward to the anterior lateral eyes, and joining these, a white band crosses above the anterior eyes; the sides below the white bands are velvety black; the anterior eyes are surrounded by hairs which are white excepting just between the eyes, where they are red; looked at from above this

gives the appearance of three minute red tufts. Clypeus black with white hairs. Abdomen black with an encircling white band and a central, longitudinal, rufus band which varies greatly in length and breadth, upon which are some variable white marks, which usually consist of two short, oblique lines near the base, a triangle in the middle, and a series of chevrons near the apex. Falces dark testaceous with sparse short white hairs; maxillæ and labium brown; sternum dark with black and white hairs; venter black with rufus hairs, palpi and legs barred with black and rufus excepting the proximal ends of the femoral joints which are pale. ♀. Cephalothorax covered with brown, black and rufus hairs, with a grayish band behind dorsal eyes, which passes downward and forward on the sides to the lateral eyes; clypeus covered with white hairs. Abdomen rufus or light brown with a grayish basal band, behind which is a curved black band; there are several other curved black bands near the apex,and a central, longitudinal black line. Falces, mouthparts and sternum brown; palpus pale with hair which is light brown excepting at the extremity, where it is white; legs, first pair dark; the others brown with black hairs.

Habitat: Pennsylvania, New York, Wisconsin.

Since describing *hoyi* and *pinus* as two species (1883) we have satisfied ourselves that *pinus* is the female of *hoyi*.

HABROCESTUM (E. Simon), 1876.

Cephalothorax rather short, one-fourth to one-third longer than wide, moderately high to very high: thoracic part often convex, but slightly dilated on the sides, which are somewhat rounded, only a third the longer. Cephalic part a little convex, inclined, limited by a faint depression. Quadrangle of eyes one-third wider than long, and equally wide in front and behind, or a little wider behind. Anterior row of eyes rather unequal — middle about twice lateral — middle but little separated, lateral by not more than one-third their diameter, forming a line straight or slightly curved upward. Second row small, and nearly half way between the first and third rows. Dorsal eyes equal to or a little larger or smaller than the anterior lateral, forming a row about as wide as the cephalothorax at that place, and almost equally distant from each other and from the lateral borders. Clypeus varies from one-half to two-thirds the large middle eyes. Sternum one-half longer than wide, often truncated in front and contracted behind, produced between the anterior coxæ, which are separated by a little more or less than the width of labium at its base. Labium as wide as long[1] and less than one-half the maxillæ. Falces weak

[1] This is true at least in the American species.

and as long as the face. Maxillæ enlarged and rounded or truncated at extremity. Legs 3, 4, 1, 2, in both sexes. The posterior pairs long, both absolutely and relatively. The first and second pairs the stoutest. All the legs spined. Femur, patella and tibia of the third much longer than the same articulations in the fourth pair. Tarsus and metatarsus of the fourth nearly equal to the patella and tibia.

This genus differs from *Saitis* E. S.— to which it is closely related — in having the quadrangle of the eyes never wider in front; usually the clypeus is more than one-half the middle eyes; the third pair of legs is longer than the fourth. In *Saitis* the third and fourth pairs are equal or almost equal.

HABROCESTUM CORONATUM Hentz.

Syn.: 1845. Attus *corontus H.*, Journal Bost. Soc. Nat. Hist., vol. V.
1875. Attus *corontus*, *id.*, Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 64.

♂. juv. Total length 5.5 mm. Width of abdomen 2 mm.

Cephalothorax: length 2.9; width 2.

Legs, 3.8, 2.4, 5.2, 4.8.

Cephalothorax high. Ocular area equally wide in front and behind. First row of eyes straight; middle eyes subtouching; lateral a little more than one-half as large as middle eyes, separated from them by one-fourth of their own diameter; eyes of second row half way between lateral and dorsal eyes; dorsal as large as lateral eyes. Clypeus two-thirds as high as middle eyes, vertical. Anterior coxæ separated by more than width of labium.

Coloration: Cephalothorax black with some white hairs over the anterior eyes, and two curved longitudinal white bands on the thoracic part. Clypeus bright red, sometimes covered with white hairs. Abdomen black, with three transverse curved white bands, one at the base, the second in front of, and the third behind the middle of the dorsum, the second and third sometimes interrupted in the middle line, and having one or two white chevrons between them; behind the third curved band is a large central white spot, and on each side of the apex is a short longitudinal white band. Falces dark brown. Mouth-parts pale drab. Sternum, coxæ and venter light brown with white hairs. Palpi and legs brown with black hairs.

Habitat: Pennsylvania, Alabama, Iowa.

HABROCESTUM CŒCATUM HENTZ.

Plate I, figure 42. Plate IV, figures 42, 42a, 42b.

Syn.: 1845. ATTUS *cœcatus* H., Journal Bost. Soc. Nat. Hist., Vol. V.
1875. " " id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 65.

♀. Total length 4.3 mm. Width of abdomen 1.7 mm.

Cephalothorax: length 2; width 1.8; height .9.

Legs, 3.6, 2.9, 4.4, 4.

Cephalothorax moderately high; cephalic part much inclined. Ocular area wider behind than in front. First row of eyes straight; middle eyes sub-touching; lateral less than one-half as large as middle eyes, separated from them by one-third their own diameter; eyes of second row half way between lateral and dorsal eyes; dorsal eyes a little smaller than lateral eyes. Clypeus retreating, two thirds as high as middle eyes. Anterior coxæ separated by fully the width of the labium.

Coloration: Cephalothorax black, with gray hairs above anterior eyes. Clypeus bright red. Abdomen black, more or less covered with whitish hairs, with a curved transverse white band, behind which are a white, diamond-shaped spot, two short, longitudinal, white bands on the sides, and two white dots near the apex. Falces, mouthparts, sternum, coxæ and venter brown, all with white hairs excepting the mouthparts. Femur of the first leg black, with a short brush of black hairs at distal end; patella and tibia covered with white hairs; metatarsus and tarsus brown; other legs dark brown with some white hairs; patella of the third with an elevation on the upper surface at the distal end; tibia of the third with a short projection which extends over the metatarsus.

Distinguished from *H. cornatum* by the projection on the tibia of the third leg.

Habitat: Pennsylvania, New York, Alabama.

HABROCESTUM VIRIDIPES HENTZ.

Plate I, figure 43. Plate IV, figures 43, 43a.

Syn.: 1845. ATTUS *viridipes* H. Jour. Bost. Soc. of Nat. Hist., Vol. V.
1875. " " id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 66.

♂. Total length 4.8 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.3; width 1.8; height 1.4.

Legs 3.5, 3.3, 5.2, 4.6; patella and tibia of the first, 1.8; patella and tibia of third, 2; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 1.9.

♀ Total length 5.8 mm. Width of abdomen 3 mm.

Cephalothorax: length 2.3; width 2; height 1.6.

Legs 3.9, 3.7, 4.8, 4.2; patella and tibia of the first, 1.6; patella and tibia of the third, 2; patella and tibia of the fourth, 1.8; metatarsus and tarsus of the fourth, 1.8.

Cephalothorax moderately high. Ocular area equally wide in front and behind. First row straight, all the eyes sub-touching; lateral less than one-half as large as middle eyes; eyes of second row half way between lateral and dorsal eyes; dorsal as large as lateral eyes. Clypeus nearly two-thirds as high as middle eyes, vertical. Anterior coxæ separated by width of labium.

Coloration: Cephalothorax black with two wide longitudinal bands of grayish hairs which arise on the posterior thoracic region and extending forward, surround the dorsal eyes, and meet just in front of them, thus occupying nearly the whole of the cephalic part. Clypeus covered with white hairs. Abdomen blackish with a basal band, a scalloped band which encircles the posterior two-thirds of the dorsum, and a central spot of a yellowish white color. The spot and the inner side of the encircling band are edged with deep black. The other parts are of a lighter or darker brown color, the sternum being sometimes much darker than the coxæ.

Habitat: Texas, South Corolina.

HABROCESTUM PEREGRINUM Peckham.

Plate I, figure 44. Plate IV, figure 44, 44a, 44b.

Syn.: 1883. Attus *peregrinum* P., Descr. new or little known Attidæ of U. S., p. 17.

♂. Total length 5.3 mm. Width of abdomen 1.9 mm.

Cephalothorax: length 2.9; width 2; height 1.2.

Legs 5.3, 4.5, 6.4, 5.6; patella and tibia of the first, 2.6; patella and tibia of the third, 2.4; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax high, especially behind; cephalic part much inclined. Ocular area a little wider behind than in front. Anterior eyes all small, in a straight row; middle eyes sub-touching; lateral a little more than one-half as wide as middle eyes, separated from them by one-third their own diameter; eyes of second row slightly nearer lateral than dorsal eyes; dorsal a little larger than lateral eyes. Clypeus two-thirds

as high as middle eyes, retreating. Two unusually stout spines on tibia of the first pair; patella of the third widening toward distal end where it projects over tibia; this widened portion bears a short pale spine which projects over tibia, just behind which, on the anterior face is a small black dot. Anterior coxæ separated by width of labium.

Coloration: Ground color of cephalothorax dark brown or black; upper surface of cephalic part covered with short fawn-colored hairs, bordered behind by a scalloped white band; thorax with two wide white bands which extend from dorsal eyes to posterior border; a wide white band extends entirely around the lower border, and below this is a narrow black line. Abdomen snowy white on sides and middle of dorsum, with two velvety black longitudinal bands extending throughout its length. Clypeus covered with thick, long, white hairs. Underparts and legs lighter or darker brown, well covered with white hairs.

This species is close to *H. Copardum* Hentz, but is distinguished from it by the apophysis on the third leg; this apophysis and the spines on the tibia of the first leg vary considerably in stoutness.

Habitat: New York, Connecticut.

HABROCESTUM CRISTATUM Hentz.

Plate I, figure 45. Plate IV, figure 45.

Syn.: 1845. Attus *cristatum* H., Journal Bost. Soc. Nat. Hist., Vol. V.
1875. " " id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 67.

♀. Total length 6.6 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 3.4; width 2.4; height 1.2.

Legs 4.8, 4.5, 6.8, 6.1; patella and tibia of the first, 2; patella and tibia of the third, 2.8; patella and tibia of the fourth, 2.2; metatarsus and tarsus of the fourth, 2.2.

Cephalothorax moderately high. Ocular area wider behind than in front. First row of eyes slightly covered; middle eyes sub-touching; lateral a little less than one-half as large as middle eyes, separated from them by one-third their own diameter; eyes of second row a little nearer dorsal than lateral eyes; dorsal as large as lateral eyes. Clypeus nearly two-thirds as high as middle eyes, retreating. Anterior coxæ separated by less than width of labium.

Coloration: Cephalothorax dark, nearly covered with grayish hair. Clypeus covered with white hairs. Abdomen covered with grayish rufus hair with two spots on the anterior part, a slender band which curves upward from the sides over the middle part, and a small ring

on the posterior region black. Falces and mouthparts dark brown. Sternum and coxæ light brown. Legs brownish rufus. Venter covered with grayish hair.

Habitat: New York, Connecticut, Alabama.

HABROCESTUM AURATUM Hentz.

Plate I, figure 46a. Plate IV, figures 46, 46a, 46b.

Syn: 1845. *Attus auratum H.*, Jour. Bost. Soc. Nat. Hist., Vol. V.
1875. " " Coll. Arachn. Writ. by N. M. Hentz, Ed. by Burgess, Boston, p. 66.

♂. Total length 5 mm. Width of abdomen 1.9 mm.

Cephalothorax: length 2.8: width 1.8; height 1.

Legs 4, 3.8, 5.8, 4.2: patella and tibia of the first, 1.8: patella and tibia of the third, 2.1; patella and tibta of the fourth, 1.6; metatarsus and tarsus of the fourth, 1.6.

♀. Total length 6.4 mm. Width of abdomen 3 mm.

Cephalothorax: length 3.2; width 2.2; height 1.1.

Legs 4.5, 4.3, 6.2, 4.8; patella and tibia of the first, 2; patella and tibia of the third, 2.4; patella and tibia of the fourth, 1.9; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax moderately high, ♀ less convex than ♂; cephalic part in clined more in ♂ than in ♀. Ocular area equally wide in front and behind. First row of eyes straight, middle eyes sub-touching; lateral a little less than one-half middle eyes, separated from them by (♀) one-third their own diameter, (♂) scarcely so much; eyes of second row very slightly nearer lateral than dorsal eyes, dorsal as large as lateral-eyes. Clypeus two-thirds as high as middle eyes, retreating. Anterior coxæ separated by scarcely the width of the labium.

Coloration: ♂. Cephalothorax covered with short black hairs which are intermingled with others of a yellowish brown color, these latter being by far the most numerous in the eye region and giving to that part its predominating tint. Three white bands come up on to the caput from the interspaces in the first row of eyes; the central one of these terminates behind the middle of the eye region: the lateral ones pass just above the small median eyes, surround the dorsal eyes and on the thoracic part curve first toward, and then away from each other, terminating at the posterior border. Around the lower margin is a black line, and just above this a band of white. Abdomen black encircled by a wide white band and having a central longitudinal white band which ends a little in front of the spinnerets. Clypeus and falces blackish brown. clypeus sparsely covered with

short, and falces with long white hairs. Sternum black, and coxæ light yellowish brown, both being covered, not very thickly, with white hairs. Venter gray, covered thickly with a mixture of black and white hairs. Legs and palpi medium brown with many white scales and some black hairs. Femur of the first with a distinct tuft of stiff black hair on the under side. Patella of the first with a small, and tibia of the first with a much larger tuft of stiff black hairs on the upper surface. ♀. Cephalothorax covered with gray hairs. Abdomen covered with gray hairs, with a basal band, two oblique bands on each side, two spots near the apex, and a central line of chevrons white. Falces reddish brown. Underparts, legs and palpi covered with short white hairs.

This species is close to *H. peregrinum* but the two species are distinguished from each other by the differences in the first and third pairs of legs.

Habitat: New York, South Carolina, Georgia.

HABROCESTUM HIRSUTUM. Nov. Sp.

Plate IV, figures 47, 47a.

♂. Total length 5.8 mm. Width of abdomen 2 mm.

Cephalothorax: length 3; width 1.7; height 1.4.

Legs 4.9, 3.9, 5.8, 5.4; patella and tibia of the first, 1.7; patella and tibia of the third, 2; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax high, slightly convex behind, dilated in the middle, with sides rounded more widely behind than in front; cephalic part plane, not inclined; thoracic sloping slightly in the first half, then more steeply. Ocular area occupying two-fifths of cephalothorax, not quite one-third wider than long, wider behind than in front. First row of eyes straight; middle eyes sub-touching; lateral less than one-half as large as middle eyes and a little separated from them; eyes of second row half way between lateral and dorsal eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus inclined backward, nearly as high as middle eyes. Falces as wide as the two middle eyes, a little shorter than face, parallel, inclined backward; fang rather long. Maxillæ parallel, short, square, truncated. Labium as wide as long, very short, rounded. Sternum oblong oval, nearly twice as long as wide, narrow. Anterior coxæ separated by width of labium; coxæ of the fourth touching. Legs of the first pair stoutest; femoral, tibial and metatarsal spines on the four pairs, and patellary spines on first and fourth; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax black, probably originally covered with short white and red hairs, with a band of white hairs and some long black hairs above the anterior eyes. Clypeus covered with red hairs. Abdomen and venter covered with short whitish brown hairs. Falces reddish brown. Mouthparts, sternum, coxæ and palpi brown. Legs brown with light hairs, first pair darkest with a fringe of stout black hairs on the tibia.

Habitat: Oregon.

HABROCESTUM SPLENDENS Peckham.

Plate I, figure 48. Plate V, figures 48, 48a.

Syn.: 1883. Attus *splendens* P., Descr. new or little known Attidæ of U. S., p. 4.

1885. Pellenes *nigroceps* Keyserling, Neue Spinnen aus Amerika, VI, Verhandlungen zoologisch-botanischen Gesellschaft., p. 26 (512).

♂. Total length 6.5 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 3; width 2.2; height 1.6.

Legs 3.9, 3.7, 4.9, 4.5; patella and tibia of the first, 1.9; patella and tibia of the third, 1.9; patella and tibia of the fourth, 1.8; metatarsus and tarsus of the fourth, 1.5.

♀. Total length 7.7 mm. Width of abdomen 2.9 mm.

Cephalothorax: length 3.1; width 2.5; height 1.3.

Legs 5.7, 4.5, 7.2, 5.8; patella and tibia of the first, 2; patella and tibia of the third, 3; patella and tibia of the fourth, 1.8; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax high and convex, a little dilated opposite dorsal eyes, sides nearly vertical in front, rounded behind; posterior margin truncated; Ocular area occupying two-fifths of cephalothorax, one-third wider than long, a little wider behind than in front; anterior row of eyes straight; middle eyes slightly separated; lateral less than one-half as large as middle eyes, separated from them by one-third their own diameter; eyes of second row half way between dorsal and lateral eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row a little narrower than the cephalothorax at that place. Clypeus (♂) nearly as high, (♀) one-half as high as middle eyes. Falces extending to inner edges of lateral eyes, but little longer than the face, vertical, parallel; fang short. Maxillæ parallel, widely separated, enlarged and blunt at extremity; labium as wide as long, a little less than one-half as long as maxillæ, blunt. Sternum narrowed at both ends, truncated in front, rounded behind; (♂) twice as long as wide, (♀) relatively shorter. Anterior

coxæ separated (♂) by scarcely width of labium, (♀) by more than width of labium. Legs of the first and second pairs stoutest; femoral, patellary, tibial and metatarsal spines on the four pairs; ♂ with spines on trochanters; metatarsi of the fourth spined throughout their length.

Coloration: ♂. Cephalothorax covered with dark but highly iridescent scales; under alcohol two whitish testaceous spots appear just behind dorsal eyes; lower margin black; some upright black hairs on anterior part of eye region. Abdomen bright iridescent red, lighter around margin, purplish on dorsum, four indented dots near base, and sometimes a whitish basal band; whole abdomen covered with sparse black hairs; spinnerets black; under alcohol the base and a curved oblique band on each side appear black, and the dorsum dark iridescent green with a short longitudinal red band, narrowest in the middle. Clypeus iridescent; falces dark reddish brown with long white hairs on their inner edges; maxillæ white at extremities and on inner edges. otherwise reddish; labium reddish tipped with white; sternum testaceous, darker than coxæ, with white hairs; coxæ covered with white hairs; palpi and legs almost black; venter iridescent red with two indistinct darker longitudinal bands. ♀. Cephalothorax rufus, or more rarely black in the eye region, with a transverse black band between the dorsal eyes; posterior to this is a scalloped white or rufus band which curves forward in the middle; behind the scalloped band the thoracic part is black; the sides are black above, and white below; the margin has a narrow black line between two white lines. Abdomen velvety black, with basal, central, and lateral white bands, which are sometimes tinted with salmon-color. Clypeus covered with white hairs; falces reddish, with white hairs on anterior face; maxillæ and labium brown; palpi and legs varied with rufus and black, with white hairs; venter covered with whitish and rufus hairs.

Count Keyserling has kindly sent us a specimen of his *Pellenes nigroceps* which we find to be identical with *H. splendens.* The female of this species is extremely variable, especially in the abdominal markings.

Habitat: Wisconsin, Massachusetts.

HABROCESTUM OREGONENSE Nov. Sp.

Plate V, figures 49, 49a.

♂. Total length 5.8 mm. Width of abdomen 1.9 mm.

Cephalothorax: length 2.5; width 1.6; height 1.

Legs 5, 3.8, 6, 5.5; patella and tibia of the first, 2.3; patella and tibia of the third, 2.5; patella and tibia of the fourth, 2; metatarsus and tarsus of of the fourth, 2.

Cephalothorax high, convex, a little dilated behind dorsal eyes, with sides slightly concave in front and a little rounded (nearly vertical) behind; cephalic part inclined; thoracic falling abruptly from a little way behind dorsal eyes. Ocular area occupying more than two-fifths of cephalothorax, one-third wider than long, equally wide in front and behind. Anterior eyes rather small, in a very slightly curved row; middle eyes sub-touching, scarcely twice as large as the lateral, which are scarcely separated from them; eyes of second row a little nearer dorsal than lateral eyes; dorsal a little smaller than lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus retreating, one-half as high as middle eyes. Falces but little wider than the two middle eyes, square, not long, parallel, a little inclined backward; fang extremely small. Maxillæ parallel, very small, wider and rounded at extremity. Labium small, a little more than one-third as long as maxillæ, as wide as long, rounded. Sternum nearly round. Anterior coxæ separated by more than width of labium at base. Legs of the first pair much the stoutest, with tibia nearly as wide as long, much enlarged in all directions, with fringes of stout hairs; patella and tibia also enlarged with some stout hairs; long and slender femoral, tibial and metatarsal spines on the four pairs, and patellary spines on the third and fourth; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax dark colored, nearly covered with bright iridescent red hairs, with which, on the cephalic part, some long black hairs are intermixed; lower border with a black line between two white lines; anterior eyes surrounded by white rings. Abdomen, venter, clypeus, falces, palpus and legs all covered with iridescent red hair. Mouthparts, sternum and coxæ very dark brown, with some short, white hairs.

Habitat: Oregon.

SAITIS PULEX Hentz.

Plate I, figures 50, 50a. Plate V, figures 50, 50a.

Syn.: 1845. Attus *pulex* H., Journal Bost. Soc. Nat. Hist., Vol. V.

1846.? Euophrys *offuscata* C. K., Die Arachn., XIII. p. 218.

1875. Attus *pulex* id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, 65.

1885. Cyrba *pulex* Keyserling, Neue Spinnen aus Amerika, VI, Verhandlungen zoologisch-botanischen Gesellschaft, p. 23 (509).

♂. Total length 4 mm. Width of abdomen 1.4 mm.

Cephalothorax: length 2.5; width 1.1; height 1.2.

Legs 2.5, 2.5, 4, 4; patella and tibia of the first, 1.3; patella and tibia of the third, 1.5; patella and tibia of the fourth, 1.5; metatarsus and tarsus of the fourth, 1.5.

♀. Total length 4.5 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 2.5; width 1.4; height 1.3.

Legs 3, 3, 4.4, 4.5; patella and tibia of the first, 1.3; patella and tibia of the third, 1.6; patella and tibia of the fourth, 1.6; metatarsus and tarsus of the fourth, 1.6.

Cephalothorax high and convex, a little dilated behind dorsal eyes, sides nearly vertical in front, and rounded behind, more widely in ♂ than in ♀; cephalic part inclined; thoracic part slanting a little from dorsal eyes, and dropping abruptly near posterior border. Ocular area occupying two-fifths of cephalothorax, one-fourth wider than long, slightly wider in front than behind. Anterior eyes on a projecting ridge, all sub-touching, in a slightly curved row; lateral about one-half as large as middle eyes; eyes of second row half way between lateral and dorsal eyes; dorsal a little smaller than lateral eyes, further from each other than from lateral borders, forming a row narrower than the cephalothorax at that place. Clypeus retreating, one-third as high as middle eyes. Falces but little wider than the two middle eyes, about as long as face, inclined backward, parallel; fang extremely weak. Maxillæ parallel, but little enlarged at extremity, (♂) almost truncated, (♀) blunt, inner edge vertical. Labium one-half as long as maxillæ, narrow and hollowed at base, enlarged in middle, contracted at tip (♂) nearly twice as long as wide, (♀) but little longer than wide. Sternum one-half longer than wide, truncated in front, narrow and rounded behind. Anterior coxæ separated by more than the width of the labium. Legs all slender; femoral, tibial and metatarsal spines on all the legs, and patellery spines on the third and the fourth; metatarsi of the fourth spined throughout their length. Femoral joints of the first and second not enlarged, but compressed, especially in ♂.

Coloration: Cephalothorax dark brown; eye region black; central thoracic region covered with gray and rufus hairs; lower margin black; reddish rings around anterior eyes. Abdomen dark brown or black; a white central band arises at base, and enlarging and then again narrowing, reaches the central point of the dorsum; posterior to this two short, oblique, white bands form a chevron whose apex, pointing forward, touches the extremity of the central band; near the apex are several small white chevrons; there is a white band on each side. The white dorsal markings in the ♀ are sometimes broken up as in figure 50; usually they resemble those of the ♂. Clypeus, falces, mouthparts, sternum and venter brown, glabrous. Palpi and legs

sometimes dark brown, sometimes pale with brown rings. Coxæ pale.

Habitat: New York, Pennsylvania, Wisconsin, Iowa, Tennessee, and Alabama.

PROSTHECLINA CAMBRIDGII Nov. Sp.

Plate I, figure 51. Plate V, figures 51, 51a.

♂. Total length 5.2 mm. Width of abdomen 2 mm.

Cephalothorax: length 2.7; width 2; height 1.9.

Legs 6.4, 5, 6, 6; patella and tibia of the first, 2.5; patella and tibia of the third, 2.1; patella and tibia of the fourth, 2; metatarsus and tarsus 2.

♀. Total length 5.8; width of abdomen 2.5.

Cephalothorax: length 2.5; width 1.8; height 1.7.

Legs 4.8, 4.5, 5.3, 5.7; patella and tibia of the first, 2; patella and tibia of the third, 2; patella and tibia of the fourth, 2; metatarsus and tarsus of the fourth, 1.9.

Cephalothorax rather high, convex, slightly dilated behind dorsal eyes, sides vertical; cephalic part inclined; ocular area occupying a little less than one-half cephalothorax, less than one-fourth wider than long, a little wider in front than behind. Anterior row of eyes a little curved; the four eyes sub-touching; lateral more than one-half as large as middle eyes; eyes of second row halfway between lateral and dorsal eyes; dorsal smaller than lateral eyes, nearer to each other than to lateral borders, in a row scarcely narrower than the cephalothorax at that place. Clypeus vertical, one-third as high as middle eyes. Falces extending to inner edges of lateral eyes, but little longer than face, vertical, parallel, fang short, weak. Maxillæ parallel, enlarged and rounded at tip; labium nearly as wide as long, a little more than one-half as long as maxillæ, rounded. Sternum nearly round, truncated in front. Anterior coxæ separated by a little more than the width of labium. Legs of the first stoutest, of the second next; femoral, tibial and metatarsal spines on the four pairs, throughout the length of the articulation on metatarsi of the fourth.

Coloration: Cephalothorax black, with some gray hairs above the anterior eyes, a white parenthesis on the anterior part of the thoracic region, and white bands on the lower sides; abdomen greyish rufus with four black spots; clypeus, falces, and sternum black with short white hairs; mouthparts and coxæ rufus; legs of the first, dark, nearly black, of the second, third, and fourth, varied with black, white and rufus, palpi rufus with black tarsi; venter covered with gray hairs.

This species agrees with the genus *Prostheclina* Keys., excepting that the relative length of the legs in the ♂ is 1, 3, 4, 2; not 1, 4, 3, 2.

Habitat: Florida.

ASTIA VITTATA Hentz.

Plate I, figure 52, 52a. Plate V, figure 52, 52a.

Syn.: 1845. Attus *vittatus* H., Jour. Bost. Soc. Nat. Hist., Vol. V.
1845. " *niger* (♂) id., ibid.
1846. Plexippus *undatus* C. K., Die Arachn., XIII, p. 123.
1848. Maevia *pencillata* (♂) C. K., Die Arachn.. XIV, p. 69.
1875. Attus *vittatus* H., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 64.
1875. " *niger* (♂) id., ibid., p. 63.

♂. Total length 7 mm. Width of abdomen 2.1 mm.

Cephalothorax: length 3; width 1.9; height 1.7.

Legs 5.4, 5, 5.1, 6.3; patella and tibia of the first, 2.8; patella and tibia of the third, 2.3; patella and tibia of the fourth, 2.8; metatarsus and tarsus of the fourth, 2.8.

♂. Total length 8 mm. Width of abdomen 2.8.

Cephalothorax: length 3.4; width 2.4; height 2.

Legs 5.7, 5.6, 6.3, 6.9; patella and tibia of the first, 3.6; patella and tibia of the third, 2.9; patella and tibia of the fourth, 3.2; metatarsus and tarsus of the fourth, 3.

Cephalothorax moderately high, nearly plane, dilated behind dorsal eyes, with sides nearly vertical in front, and rounded behind; cephalic part a little inclined forward; thoracic part slanting but little in the first half, steeply in the second. Ocular area occupying two-fifths of the cephalothorax, one-third wider than long, a little wider in front than behind; anterior eyes projecting forward, in a straight row; middle eyes touching; lateral one half as large as middle eyes, and slightly separated from them; eyes of second row half way between lateral and dorsal eyes; dorsal a little smaller than lateral eyes, further from each other than from the lateral borders, forming a row not quite so wide as the cephalothorax at that place. Clypeus (♂) one-half, (♀) one-third as high as middle eyes, slightly inclined. Falces (♀) but little wider than middle eyes, one-half longer than face, vertical, parallel; ♂ weaker and shorter than in ♀; fang weak. Maxillæ parallel, enlarged and rounded at extremity; labium a little longer than wide, one-half as long as maxillæ, contracted and blunt at tip. Sternum nearly twice as long as wide, scarcely projecting between anterior coxæ; anterior coxæ almost touching. (♀) first legs stoutest with femur, patella and tibia enlarged; (♂ ♀) with spines on trochanters, femora, patellæ, tibiæ and metatarsi of the four pairs, those on the femora numerous at the distal ends; (♂) legs and spines weaker than in ♀.

Coloration: ♂. Presenting two distinct varieties; the first has the thoracic part of the cephalothorax light brown and glabrous with a cen-

tral, longitudinal, black line, while the eye region is black with some short white hairs; the abdomen is mottled with black, red and white, sometimes with alternate white and red chevrons on the central region; clypeus white; falces, mouthparts, sternum and coxæ pale; venter covered with short white hairs; legs white with black spots and spines, and underneath on the fermoral joints, characteristic, oblique, black bars; the second variety (*niger*) has the cephalothorax black, with a pale spot, divided by a longitudinal, black line, in the central thoracic region, and, on the posterior part of the eye region, forming a transverse row, three long tufts of black hairs; abdomen black; clypeus, palpi, falces, sternum, mouthparts, venter and sometimes coxæ very dark or black; legs pale, with a yellowish tint in comparison with the white legs of the first variety, tipped with black. Intermediate between these varieties is one which is nearly as dark as *niger*, with pale legs, but without the cephalic tufts. So unlike in general appearance are the extreme forms that they were placed by C. Koch in two different genera (*Plexippus undatus*, Die Arachniden, xiii, fig. 1183, and *Maevia pencillata*, Die Arachniden, xiv, fig. 1325). As this is an extremely common species we have compared large numbers of them, but have never found the tufts present in the first variety, which most resembles the ♀. ♀. Cephalothorax light brown in thoracic part, black in eye region, with short white and red hairs; abdomen white on sides and central dorsum, with two longitudinal bright red bands; in rubbed specimens the central region and sides are pale flecked and striped with reddish, and the bands are dark red; clypeus, falces, mouthparts, sternum, coxæ, palpi and legs pale; venter covered with short white hairs.

Habitat: United States.

ASTIA (?) MOROSA Nov. Sp.

Plate I, figure 53. Plate V, figures 53, 53a.

♂. Total length 5 mm. Width of abdomen 2.1 mm.

Cephalothorax: length 2.4; width 1.8; height 1.3.

Legs 5.4, 4, 5.1, 5.3; patella and tibia of the first, 2.5; patella and tibia of the third, 2.2; patella and tibia of the fourth, 2.2; metatarsus and tarsus of the fourth, 1.9.

♀. Total length 6 mm. Width of abdomen 3.2 mm.

Cephalothorax: length 2.9; width 2; height 1.7..

Legs 5.8, 4.9, 6.3, 6.8; patella and tibia of the first, 2.4; patella and tibia of the third, 2.3; patella and tibia of the fourth, 2.6; metatarsus and tarsus of the fourth, 2.4.

Cephalothorax high, especially behind, convex, a little dilated in the middle, with sides vertical in front and a little rounded behind; cephalic part plainly inclined; thoracic part slanting quite abruptly from a little behind dorsal eyes, the cephalothorax being evidently highest in the middle. Ocular area occupying a little more than one-third of cephalothorax, one-third wider than long, a little wider in front than behind. First row of eyes straight; middle eyes touching, lateral more than one-half as large as middle eyes, (♀) touching them, (♂) separated from them by one-fourth their own diameter; eyes of second row half way between dorsal and lateral eyes; dorsal as large as lateral eyes, (♂) equally distant from each other and lateral borders, (♀) a little nearer each other. Clypeus (♂) one-fourth, (♀) one-fifth as high as middle eyes, (♂) retreating, (♀) vertical. Falces as wide as the two middle eyes, (♂) a little longer than face, (♀) as long as face, parallel, inclined backward; fang weak, maxillæ parallel, narrow at base, enlarged at extremity, and truncated. Labium as wide as long, less than one-half as long as maxillæ, contracted at tip. Sternum nearly twice as long as wide, rounded in front, pointed behind. Anterior coxæ separated (♀) by width of labium, (♂) more widely. Legs (♂) of the first very slightly stouter than the others, (♀) equally stout; femoral, tibial and metatarsal spines on the four pairs; (♂) with patellary spines; metatarsi of the fourth spined throughout their length.

Coloration: ♂. Cephalothorax pale in thoracic part, much darker in eye region, probably originally covered with short white hairs; marginal line black; middle anterior eyes surrounded by rings of white hairs. Clypeus reddish brown. Abdomen with a black central longitudinal line over the anterior part of the dorsum, which bifurcates posteriorly, thus bounding a large triangular pale spot; this spot is limited behind by some irregular black marks; the sides are pale with black dots and spots. Falces, mouthparts, sternum and coxæ all light brown. Venter pale with black dots. Legs brown with black rings and tips, the color being considerably darker on the last three joints of the first leg. ♀. Cephalothorax and abdomen black, almost covered with mixed red and gray hairs; on the abdomen these hairs are thick at the base, and form three wide longitudinal bands, one central and two lateral, over the dorsum, and a large trirngular spot behind the middle point; near the apex, on each side, are two white dots, the anterior larger and a little external to the posterior. Clypeus covered with short white hairs. Falces dark brown. Mouthparts, sternum and coxæ light brown. Legs and palpi brown with darker rings. Venter pale with irregular black dots.

Habitat: California.

MÆVIA CALIFORNICA Nov. Sp.

Plate V, figures 54, 54a.

♂. Total length 6 mm.

Cephalothorax: length 2.1; width 1.5; height 1.2.

Legs 5.7, 4.5, 4.5, 5.5; patella and tibia of the first, 2.3; patella and tibia of the third 1.9; patella and tibia of the fourth, 2.1; metatarsus and tarsus of the fourth, 2.

Cephalothorax high, convex; sides nearly parallel, almost vertical in front, and rounded behind; cephalic part very slightly inclined; thoracic slanting from just behind dorsal eyes. Ocular area occupying two-fifths of cephalothorax, one-third wider than long, equally wide in front and behind. Anterior eyes small, sub-touching, in a slightly curved row; middle scarcely twice as large as lateral eyes; eyes of second row a little nearer lateral than dorsal eyes; dorsal as large as lateral eyes, nearer to each other than to lateral borders, forming a row about as wide as cephalothorax at that place. Clypeus one-half as high as middle eyes, slightly inclined backward. Falces nearly as wide as first row of eyes, one and one-half times as long as face, parallel, slightly inclined backward; fang moderately long. Maxillæ parallel, enlarged at the extremity, with projection at outer corner. Labium less than one-half as long as maxillæ, as wide as long, rounded. Sternum plane, a little longer than wide, truncated in front, rounded behind. Anterior coxæ separated by width of labium. Legs of the first and second pairs stoutest with femoral joints compressed; tibial and metatarsal spines (stoutest on first and second), on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Entire spider black, excepting the tarsi and sometimes the distal ends of the metatarsi, which are pale.

Habitat: California.

CYTÆA (?) MINUTA Nov. Sp.

Plate I, figure 55. Plate V, figures 55, 55a.

♂. Total length 4.8 mm. Width of abdomen 1.6 mm.

Cephalothorax: length 2.1; width 1.6; height 1.1.

Legs 4, 3, 3. 6, 3; cephalothorax much longer than patella and tibia of the first; patella and tibia of the third longer than patella and tibia of the fourth; patella and tibia of the fourth and metatarsus and tarsus of the fourth equal.

♀. Total length 5 mm. Width of abdomen 1.6 mm.

Cephalothorax: length 2.3; width 1.5; height 1.1.

Legs 3.8, 3.5, 4.1, 4.8; cephalothorax much longer than patella and tibia of the first; patella and tibia of the third shorter than patella and tibia of the fourth; patella and tibia of the fourth and metatarsus and tarsus of the fourth equal.

Cephalothorax low, flat, a little contracted behind, with sides nearly vertical in front, and slightly rounded posteriorly; cephalic part not inclined; thoracic part level in the first half, then falling steeply. Ocular area occupying a little less than two-fifths of cephalothorax, one-fourth wider than long, equally wide in front and behind. Anterior eyes sub-touching, in a straight row; middle scarcely twice as large as lateral eyes; eyes of second row halfway between lateral and dorsal eyes; dorsal as large as lateral eyes, further from each other, nearly as wide as cephalothorax at that place. Clypeus scarcely perceptible. Falces as wide as first row of eyes, a little longer than face, vertical, parallel; fang short and weak. Maxillæ parallel, enlarged at extremity, (♂) with small projection at outer corner. Labium more than one-half as long as maxillæ, longer than wide, contracted and rounded at tip. Sternum one-fourth longer than wide, truncated in front. Anterior coxæ separated by width of labium. Legs nearly equally stout; femoral, tibial and metatarsal spines on the four pairs; on tibiæ and metatarsi of the third and fourth more above than below; metatarsi of the fourth spined throughout their length.

Coloration. ♂. Cephalothorax with thoracic part dark brown, and cephalic part with short rufus and long black hairs, three reddish tufts appearing between the anterior eyes, which are surrounded by red rings; there are three longitudinal white bands, one central, running from the anterior eyes to the posterior border, and one on each lower side above the black marginal line. Clypeus covered with yellowish white hairs. Abdomen dark brown or blackish with a central longitudinal abbreviated white line not reaching the middle, and, on each side, a longitudinal white line which reaches beyond the middle, posterior to which are three transverse curved white marks, one behind the other. Falces and mouthparts dark brown. Palpi covered with thick white hairs above, and sparse black hairs below. Sternum, coxæ and legs light brown, the legs with darker rings, and tipped with black. Venter covered with white hairs. ♀. Cephalothorax resembling that of ♂ but with a greater tendency to reddish color in the eye region, with the white of the bands not so clear, and with the central band extending only from the dorsal eyes to the posterior border. Abdomen dark brown or blackish, with a wide, notched, central, longitudinal white band extending nearly to the apex, just behind which, on each side, is a short, oblique, white line; there is a white transverse band at the apex, and, on each side of the dorsum, a longitudinal row of four or

five white spots. Palpi pale with white hairs. Other parts like ♂ excepting that the legs are paler.

Habitat: California.

CYRBA TÆNIOLA Hentz.

Plate I, figure 56. Plate IV, figure 56a. Plate V, figures 56, 56b.

Syn.: 1845. Attus *tæniola* H., Journal Bost. Soc. Nat. Hist. Vol. V.
1875. " " id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 56.

♂. Total length 4 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.2; width 1.8; height 1.2.

Legs 4.8, 3.6, 3.6, 5.1; patella and tibia of the first, 2; patella and tibia of the third, 1.3; patella and tibia of the fourth, 2.2; metatarsus and tarsus of the fourth, 1.7.

♀. Total length 6.7 mm. Width of abdomen 2.2 mm.

Cephalothorax: length 2.7; width 2.1; height 1.2.

Legs 4.4, 3.6, 3.7, 4.9; patella and tibia of the first, 2; patella and tibia of third, 1.6; patella and tibia of the fourth, 2.3; metatarsus and tarsus of the fourth, 1.7.

Cephalothorax low, flat, sides nearly parallel, and almost vertical in front, rounded behind; cephalic part a little inclined; thoracic part almost level in anterior three-fourths, then falling abruptly. Ocular area occupying a little less than one-half cephalothorax, one-third wider than long, equally wide in front and behind. Anterior eyes projecting, in a straight row; middle eyes touching; lateral one-half as large, and scarcely separated from middle eyes; eyes of second row nearer lateral than dorsal eyes; dorsal not so large as lateral eyes, further from each other than from lateral borders, forming a row nearly as wide as cephalothorax at that place. Clypeus vertical, one-fifth as high as middle eyes. Falces but little wider than the two middle eyes, one-half longer than face, vertical, parallel; fang weak and short. Maxillæ widely separated, parallel, long, a little enlarged and rounded at extremity. Labium one-half as long as maxillæ, a little longer than wide. (♂) truncated, narrower than in ♀, (♀) blunt. Sternum not projecting between anterior coxæ, rounded in front and behind, (♂) one-fourth longer than wide, (♀) twice as long as wide. Anterior coxæ nearly touching. Legs of the first much the stoutest, with femoral joints compressed; tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax black, with lower margin white. Abdomen black with two longitudinal rows of white dots or abbreviated lines. Clypeus, falces, mouthparts, sternum, coxæ, palpi and venter black.

Legs of the first and second pairs black, excepting metatarsi and tarsi which are light rufus; third and fourth light rufus, excepting femoral joints which are black.

Habitat: Pennsylvania, South Carolina, Alabama, Georgia, Florida, Wisconsin.

EPIBLEMUM SCENICUM Clerck.

Plate 1, figure 57. Plate IV, figure 57.

Syn.: 1757. Araneus *scenicus Cl.*, Sv. Spindl., p. 117 (saltem ad. part.)
1758. Aranea *scenica* Linn., Syst. Nat., Ed. 10, I, p. 623, (saltem ad part.)
1778. " *albo-fasciata* De Geer, Mem., vii, p. 287 (saltem ad part.)
1805. Attus *scenicus* Walck. Tabl. d. Aran., p. 24 (ad part).
1806. Salticus *scenicus* Latr., Gen. Crust. et Ins., I, p. 123 (saltem ad part).
1825. Attus *scenicus*, Walck., Faune Franc., Arachn., p. 44 (ad part).
182?. " " Hahn. Monogr. Aran., 4, Pl. I, figs. A, B.
1831. Salticus " *id.*, Die Arachn, I. p. 57 (saltem ad part.)
1832. Epiblemum *faustum* Hentz, Am. Jour. Science and Arts, xxi, p. 108.
1833. Attus *scenicus* Sund., Sv. Spindl. Beskrifn., in Vet.-Akad. Handl. f. 1832, p. 202.
1837. Calliethera *scenica* C. Koch, Uebers. d, Arachn-Syst., I, p. 31.
1837. " *histrionica* id., ibid.
1846. " " id., Die Arachn., xiii, p. 42.
1846. " *scenica* id., ibid, p. 37.
1846. " *anlica* id., ibid, p. 51.
1846. Salticus *propinquus* Lucus, Expl. Alg., Ar., p. 162.
1846. " *albovittatus* id., ibid, p. 164.
1846. Epiblemum *faustum* Hentz, Journal Bost. Soc. Nat. Hist., v. p. 367.
1856. Calliethera *histrionica* Thorell; Rec. crit. Aran., p. 68.
1856. " *scenica* id., ibid (ad part).
1861. Salticus *scenicus* Blackw., Spid. of Gr. Brit., I, p. 47.
1869. Callietherus *histrionicus* Sim., Monogr. d. Att. d'Eur., p. 650 (184).
1870. Epiblemum *histrionicum* Thorcel. on Eur. Spid., p. 211.
1872. Epiblemum *scenicum* id., ibid, II, p. 360.
1876. Calliethera *sceinca Sim*, Arachnides de France, III, p. 64.

1880. EPIBLEMUM *scenicum* Workman, Irish Spid., Belfast Nat. Hist. Soc., p. 16.

1883. " " Campbell, Spid. of Hoddesdon, Hertfordshire Nat. Hist. Soc., p. 276.

1884. CALLIETHERA *scenica Sim,*., Arachnides de Miranda de Ebro, Soc. Esp. de Hist. Nat.. xiii, 114 (2).

1885. " " *id.*, Arachnides de Tunisie, p. 3.

♂. Total length 4.9 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.5; width 1.9; height 1.1.

Legs 3.9, 2.7, 2.7, 3.2.

♀. Total length 5.5 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.2; width 1.3; height 1.2.

Legs 3.8, 2.5, 3.2, 4.

Cephalothorax moderately high, slightly convex, a little dilated behind dorsal eyes, with sides almost vertical in front, and rounded behind; cephalic part slightly inclined; thoracic part falling gradually until the last one-third and then steeply. Ocular area occupying a little more than one-third of the cephalothorax, one-third wider than long, equally wide in front and behind. First row of eyes straight; middle eyes touching; lateral one-half as large as middle eyes, and scarcely separated from them; eyes of second row halfway between lateral and dorsal eyes; dorsal nearly as large as lateral eyes, further from each other than from lateral border, forming a row scarcely narrower than the cephalothorax at that place. Clypeus vertical, one-fourth as high as middle eyes. Falces not quite so wide as first row of eyes, (♂) four times as long as face, horizontal, diverging, with two teeth on distal third; fang long; (♀) one and one-half as long as face, vertical, parallel, fang short. Maxillæ long, (♂) truncated at tip, slightly diverging; (♀) rounded, parallel. Labium a little longer than wide, slightly contracted at tip, (♂) less than one-half, (♀) more than one-half maxillæ. Sternum rounded behind, truncated in front, about twice as long as wide, relatively wider in ♂ than in ♀. Anterior coxæ separated by width of labium. Legs of the first pair a little the stoutest; metatarsal spines on the third and fourth in terminal circles; (♀) femoral and tibial spines as well.

Coloration: Cephalothorax dark brown, with clypeus and lower border white, and two white spots in the anterior thoracic region. Abdomen rufus, with a basal band and two slightly oblique bands on each side of dorsum white. Falces dark brown, mouthparts and sternum blackish, with white hairs; coxæ brown. Palpi and legs light brown, with darker rings. Venter blackish, with white hairs.

Habitat: North America, Europe, North Africa.

ADMESTINA Nov. Gen.

Cephalothorax low and plane, a *little* widest opposite the middle of thoracic part, more contracted in front than behind, less than twice as long as wide, the cephalic and thoracic parts not separated. The thoracic part is twice as long as the cephalic part, and is truncated behind. In front the sides are nearly vertical while behind they are rounded. Quadrangle of eyes much wider — nearly twice — than long, and very little wider behind. Anterior row a little curved upward, the middle twice the lateral and near together; the lateral separated from the middle by almost one-half their own diameter. Second row small and placed two-fifths from the anterior lateral. Dorsal eyes slightly larger than lateral and as wide as the cephalothorax at that place; plainly further from each other than from the lateral borders. Clypeus one-half as high as the large middle eyes. Sternum nearly oval, not produced between the coxæ of the first pair, which are nearly touching. Maxillæ enlarged and blunt at the extremity. Labium as wide as long, and less than half of the maxillæ. Falces weak, wide as middle eyes, and a little longer than the face, vertical, parallel. Legs 4, 1, 3, 2; first pair stoutest; the tibia and patella of the first much shorter than the cephalothorax. Tibia and patella of the third shorter than tibia and patella of the fourth, the latter longer than the tarsus and metatarsus of the fourth. Legs without spines except on metatarsus of the first pair. Abdomen rather long and narrow. Nearest *Hyctia* Simon, but differs in the much greater width of the quadrangle of the eyes, in the quadrangle being wider behind, not parallel; and the relative length of the legs. The sternum is not narrow.

ADMESTINA WHEELERII Nov. Sp.

Plate I, figure 58. Plate V, figure 58.

♂. Total length 3.7 mm. Width of abdomen 1.2 mm.

Cephalothorax: length 1.6; width 1; height 6.

Legs 2.3, 1.9, 2.1, 2.7; patella and tibia of the first, 1; patella and tibia of the third, 8; patella and tibia of the fourth, 1; metatarsus and tarsus of the fourth, 8.

Coloration: Cephalothorax and clypeus black. Abdomen pale, with a central longitudinal branching dark band. Falces and mouthparts dark brown. Sternum black. Coxæ dark brown, excepting those of the fourth pair which are pale. Venter pale with a wide, central dark band. Palpus brown. Legs pale with dark rings.

Habitat: Wisconsin.

HYCTIA PIKEI Nov. Sp.

Plate I, figure 59. Plate IV, figure 59a. Plate V, figure 59.

♂. Total length 8.2 mm. Width of abdomen 1.1 mm.

Cephalothorax: length 2.9; width 1.8; height .9.

Legs 7.1, 4, 3.6, 4.6; patella and tibia of the first, 3.1; patella and tibia of the third, 1.5; patella and tibia of the fourth, 1.9; metatarsus and tarsus of the fourth, 1.4.

♀. Total length 8.5 mm. Width of abdomen 1.1.

Cephalothorax: length 2.9; width 1.8; height .9.

Legs 6.3, 3.3, 3, 5; patella and tibia of the first, 2.8; patella and tibia of the third, 1.3; patella and tibia of the fourth, 2; metatarsus and tarsus of the fourth, 1.4.

Cephalothorax very low, flat, long and slender, being nearly twice as long as wide, contracted in front, the dilation beginning just in front of the dorsal eyes and increasing in the thoracic part; cephalic part plane, not inclined, sides vertical; thoracic part with sides a little rounded, sloping gradually from dorsal eyes to posterior margin. Ocular area occupying about one-third of cephalothorax, very little wider than long, equally wide in front and behind; anterior row of eyes distinctly visible from above, straight; lateral about one-third as large as middle eyes, scarcely separated from them; middle eyes touching; eyes of second row very small, halfway between lateral and dorsal eyes; dorsal smaller than lateral eyes, much farther from each other than from lateral borders, forming a row which is as wide as the cephalothorax at that place. Clypeus only a line. Falces extending in width to inner edges of lateral eyes, but little longer than face, vertical, parallel. Maxillæ parallel, long, narrow, truncated. Labium more than one-half as long as maxillæ, longer than wide, pointed. Sternum very long and narrow. Anterior coxæ (♂) very close together but separated by anterior end of sternum; (♀) separated by width of labium. Coxæ of fourth pair touching; second and third pairs of coxæ separated from each other by a considerable interval. First pair of legs much the longest and stoutest, with trochanters visible from above, and tibiæ enlarged. Femoral, tibial and metatarsal spines on the four pairs, and one small patellary spine on the first; spines on the tibiæ and metatarsi of the first very long and stout, on the third and fourth exceedingly weak and far apart. Abdomen, very long, slender and low.

Coloration: ♂. Cephalothorax very dark brown, blackish on eye region with some black hairs, and yellowish on the sides, with a black marginal line; abdomen with a wide, central, longitudinal, black band from base to apex, and some stiff black hairs at base; on each side below the black band, a band of whitish hairs; falces dark brown;

mouthparts light brown; sternum, coxæ and venter yellowish, first pair of legs dark brown, the others yellowish tipped with black. ♀. Much like ♂ but lighter in color; cephalothorax showing a slender, central, longitudinal black line from the middle of the cephalic to nearly the middle of the thoracic part; the central band on abdomen dark brown, the sides lighter, but not white; first legs darker than the others but lighter than in ♂.

Easily distinguished, as the abdomen is more than three time as long as wide.

Habitat: New York, South Carolina, Georgia, Florida.

MARPTUSA FAMILIARIS Hentz.

Plate I, figure 60. Plate IV, figure 60a. Plate V, figure 60.

Syn.: 1845. Attus *familiaris*, H., Journal Bost. Soc. Nat. Hist., Vol. V.
1846. Marpissa *undata*, C. K., Die Arachn. XIII, p. 60.
1846. " *conspersa* (♂) id., ibid., XIII, p. 61.
1846. " *varia*, id., ibid., XIII, p. 69.
1875. Attus *familiaris*, H., Coll. Arachn. Writ. by N. M. Hentz, Ed. by Burgess, Boston, p. 56.

♂. Total length 9.5 mm. Width of abdomen 2.9 mm.

Cephalothorax: length 4.4; width 3.2; height 2.1.

Legs 10.6, 8.4, 8.3, 10; patella and tibia of the first, 4.4; patella and tibia of the third, 2.9; patella and tibia of the fourth, 3.3; metatarsus and tarsus of the fourth, 2.9.

♀. Total length 10.5 mm. Width of abdomen 3.5 mm.

Cephalothorax: length 4.5; width 3.5; height 1.8.

Legs 9, 7.7, 7.7, 9.1; patella and tibia of the first, 3.8; patella and tibia of the third, 3; patella and tibia of the fourth, 4; metatarsus and tarsus of the fourth, 2.9.

Ocular area occupying less than one-third of cephalothorax, nearly twice as wide as long, and equally wide in front and behind. Anterior eyes in a scarcely curved row, the lateral less than one-half as large as the middle eyes, and separated from them by one-half their own diameter, while the middle eyes are slightly separated from each other; eyes of the second row halfway between lateral and dorsal eyes; dorsal a little smaller than lateral eyes, placed (♂) a little, (♀) plainly further from each other than from the lateral borders, forming a row much narrower than the cephalothorax at that place. Clypeus nearly vertical, rather less than one-half as high as middle eyes. Falces extending, in width, to the inner edges of the lateral eyes; one-half longer than face, parallel, vertical; fang short. Maxillæ parallel, enlarged and rounded at extremity. Labium a little

more than one-half as long as maxillæ, as wide as long; contracted and blunt at tip. Sternum one-half longer than wide, a little narrower in front than behind. Anterior coxæ separated by scarcely the width of the labium. Femoral, tibial and metatarsal joints of the first and second pairs enlarged. Metatarsi and tarsi slender; femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax rufus, darkest in the eye region, with short dense gray hairs, and a few long black hairs on each side in front; lower borders black; abdomen dark brown with the central region occupied by a wide, light gray, scalloped, longitudinal band; clypeus covered with long white hairs; falces dark reddish brown; sternum brown; palpus with a short brush of black hairs; legs dark brownish red, covered with adpressed white and upright black hairs. Venter pale gray, with a central longitudinal brown band which tapers to a point near the apex.

Habitat: United States, Mexico.

MARPTUSA CALIFORNICA Nov. Sp.

Plate I, figure 61. Plate V, figure 61. Plate VI, figure 61 a.

♂. Total length 9.2 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 3.8; width 2.9; height 1.8.

Legs 8.4, 7.4, 7.5, 8; patella and tibia, 3.6; patella and tibia of the third, 3; patella and tibia of the fourth, 3.5; metatarsus and tarsus of the fourth, 2.5.

♀. Total length 9 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 3.8; width 2.9; height 1.5; relative length of legs, 4, 1, $\overline{2\ 3}$.

Ocular area occupying a little more than one-third of cephalothorax, one-third wider than long, equally wide in front and behind. Anterior eyes in a slightly curved row; lateral one-half as large as middle eyes, separated from them by one-half their diameter; middle eyes subtouching; eyes of second row very slightly nearer lateral than dorsal eyes; dorsal not quite so large as lateral eyes, (♂) slightly nearer each other than lateral borders, (♀) further from each other, forming a line narrower than cephalothorax at that place. Clypeus vertical, one-half as high as middle eyes. Falces rather short and weak, vertical, parallel. Maxillæ parallel, enlarged and rounded at extremity. Labium more than one-half as long as maxillæ, as wide as long, rounded at tip. Sternum nearly plane, one-third longer than wide, widest in middle. Anterior coxæ separated by a little less than the width of labium. Femoral, patellary and tibial joints of the first

and second pairs, enlarged; femoral, tibial and metatarsal spines on the four pairs; those on the metatarsus of the fourth, throughout their length.

Coloration: Cephalothorax very dark brown covered with gray hairs, with whitish hairs around the eyes; central upper surface of abdomen occupied by a wide, angular gray band; sides black with mixed gray and tawny hairs; clypeus with white hairs; sternum, coxae and mouthparts brown; sternum with some white hairs; falces brown; venter black; legs, excepting the tarsi, which are light in color, blackish with much gray and tawny hair.

Habitat: California.

MENEMERUS MELANOGNATHUS H. Lucas.

Plate I, figures 62, 62a. Plate VI, figures 62, 62a.

Syn.: 1839. (?). Salticus *melanognathus* H. Lucas, Webb and Berthelot's Hist. Nat. des Iles Canaries, Tom. II, p. 29, pl. VII, fig. 4.

1846. Marpissa *dissimilis* C. L. Koch, Die Arachn., XIII, p. 70, Tab. CCCCLIV, figs. 1135 and 1136.

1846. " *incerta* id.. ibid., p. 73, Tab. CCCCLIV, fig. 1138.

1859. Salticus *convergens* Doleschall, Tweede Bijdr. Arachn. Indischen Archipel, p. 15, Tab. IX, fig. 4.

1863. Attus *muscivorus* A. Vinson, Araneides des Iles de la Reunion, etc., p. 47, Pl. X, fig. 1.

1867. Attus *foliatus* L. Koch, Arach., etc., Verhandl. zool. and bot. Ges., in Wien, 1867, p. 226.

1870. Salticus *nigro-limbatus* Cambridge, Proceed. Zool. Soc. of London, 1869, p. 542, Pl. XLII, fig. 10.

1873. " *nigro-limbatus*, id., Transact. of the Linn. Soc. of London, XXVII, p. 527.

1874. Marpissa *nigro-limbatus*, *id.*, Syst. list of Spiders of Gr. Britain and Ireland, ibid., XXX, p. 333.

1876. " *nigro-limbatus*, E. Simon, Arachnides de France, T. III, p. 29.

1878. Icius (?) *convergens* Thorell, Studi, etc., II, Ragni di Amboina, pp. 232, 309.

1879. Marptusa *marita* Karsch, West-Afrik. Arachn. in Zeitschr. f. die gesammt. Naturwissensch, LII, p. 338.

1879. Menemerus *foliatus* L. Koch, Arachn. Australiens, p. 1123, T. XCVIII, figg. 1, 2.

1881. Icius (?) *dissimilis* Thorell, Studi, etc., III, Ragni Malesi e. Papuani, p. 461.

1883. Attus *mannii* Peckham, New or little known spiders of the family Attidæ. p. 27, Pl. III, fig. 21.

1883. Menemerus, *melanognathus* E. Simon, Arachn. de l'Ocean Atlantique, Soc. Entom., France, pp. 284, 306.

We have *Attus muscivorus* Vinson from both Madagascar and Reunion, and find it to be identical with *M. melanognathus.*

♂. Total length 8 mm. Width of abdomen 2.7 mm.

Cephalothorax: length 3.3; width 2; height 1.3.

Legs 7.8, 7.2, 5.9, 7.9; patella and tibia of the first, 3.6; patella and tibia of the third, 2.2; patella and tibia of the fourth, 3; metatarsus and tarsus of the fourth, 2.3.

♀. Total length 9.5 mm. Width of abdomen 3.6 mm.

Cephalothorax: length 3.8; width 3; height 1.5.

Legs 6.8, 6.5, 7.4, 8.5; patella and tibia of the first, 2.8; patella and tibia of the third, 2.5; patella and tibia of the fourth, 3.3; metatarsus and tarsus of the fourth, 3.

Cephalothorax low and flat, dilated behind dorsal eyes, with sides almost vertical in front and rounded widely behind; cephalic part scarcely inclined; thoracic part slanting very gradually until near the posterior border. Ocular area occupying less than two-fifths of cephalothorax, one-fourth wider than long, equally wide in front and behind. First row of eyes straight; middle eyes sub-touching; lateral rather more than one-half as large as middle eyes, and slightly separated from them; eyes of second row half way between lateral and dorsal eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row narrower than the cephalothorax at that place. Clypeus scarcely one-fifth as high as middle eyes, vertical. Falces nearly as wide as the first row of eyes, more than twice as long as face, vertical, diverging a little at the extremities. Maxillæ parallel, long, narrow at base, rounded. Labium two-thirds as long as maxillæ, twice as long as wide, a little shorter in ♀ than in ♂, rounded at tip. Sternum deep set, nearly twice as long as wide, contracted in front, rounded behind. Anterior coxæ separated (♂) by about the width of the labium, (♀) a little less. Legs of the first pair a little stoutest. Femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax dark brown, with rufus hairs over anterior eyes, a wide white band low on each side, and a large patch of white hairs on the central thoracic region. Clypeus dark in the middle, with an oblique line of white hair on each side, these lines beginning below the anterior lateral eyes and extending over the clypeus and along the inner edges of the dark brown falces. Abdomen dark rufus with two wide longitudinal white bands composed of both short and long white hairs, and two black chevrons at the apex. Palpus with femur covered with white hairs, and tarsus black. Legs rufus with dark rings and a good many white hairs. Mouthparts, sternum and coxæ very dark, with white hairs. Venter gray with a wide central rufus band.

Habitat: Cosmopolitan. Florida, Mexico, Guatemala, Brazil, Islands of the Atlantic, England, France, Africa, Madagascar, Australia, Malay Archipelago.

MENEMERUS PAYKULLII Aud.

Plate I, 63. Plate VI, figures 63, 63a.

Syn.: 1825–27. Attus *paykullii* Aud. in Sav. Descr. de l' Egypte, 2. Edit., XXII, p. 172.
1837. " " Walck., Hist. Nat. des Insectes Aptères, I, p. 426.
1837. " *ligo* id., ibid., p. 426.
1845. " *binus* Hentz, Journal Bost. Soc. Nat. Hist., Vol. V.
1846. Plexippus *ligo* C. K., Die Arachn., XIII, p. 107.
1849. Salticus *vaillantii* Lucas, Expl. de l' Algerie Zool., I, p. 136.
1863. Attus *africanus* Vinson, Aran. des iles de 'la Réunion, Maurice et Madagascar, p. 52.
1865. Euophrys *delibuta* L. Koch, Verhandl. d. zool. bot. Ges. in Wien, p. 874.
1875. Attus *binus* Hentz, Coll. Arachn. Writ. by N. M. Hentz, ed. by Burgess, Boston, p. 54.
1876. Hasarius *paykullii* Sim., Arachnides de France, III, p. 81.
1881. Menemerus (?) " Thorell. Studi Sui Ragni Mal. et Pap., III, p. 501.
1881. " " Keyserling, Koch and Keyserling's, Die Arachn. Austral., p. 1461.
1885. " " Sim., Faune Archnologique de l' Asie Mérid., Bull. de la Soc. Zool. de France, p. 7.

We have *Attus africanus* Vinson from Madagascar and find it identical with *M. paykullii.*

♂. Total length 9 mm. Width of abdomen 2.7 mm.

Cephalothorax: length 4.5; width 3.1; height .2.

Legs 11, 9.2, 9.5, 10.5; patella and tibia of the first, 5; patella and tibia of the third, 3.5; patella and tibia of the fourth, 4; metatarsus and tarsus of the fourth, 4.

Cephalothorax high, convex, a little dilated behind dorsal eyes, with sides nearly vertical in front, and rounded behind; cephalic part inclined; thoracic part falling gradually from a little way behind dorsal eyes nearly to posterior border, then abruptly. Ocular area occupying two-fifths of cephalothorax, one-fourth wider than long, slightly wider in front than behind. Anterior eyes all projecting, in a curved row; middle eyes subtouching; lateral rather more than one-half as large as middle eyes, separated from them by one-third their own diameter; eyes of second row a little nearer lateral than dorsal eyes; dorsal smaller than lateral eyes, equally distant from each other and the lateral borders, forming a row narrower than the cephalothorax

at that place. Clypeus retreating, one-half as high as middle eyes. Falces not much wider than the two middle eyes, three times as long as face, vertical, parallel; fang not long. Maxillæ parallel, enlarged and rounded at extremity. Labium one-half as long as maxillæ, a little longer than wide, contracted and blunt at tip. Sternum nearly twice as long as wide, rounded behind, slightly contracted in front. Anterior coxæ separated by nearly the width of the labium. Legs of the first and second pairs stoutest; with femoral joints enlarged and compressed; femoral, patellary, tibial and metatarsal spines on the four pairs, those on third and fourth especially stout; metatarsi of the fourth spined throughout their length. There are some stout femoral spines on the palpus.

Coloration: Cephalothorax and abdomen white, with two wide longitudinal black bands extending from anterior eyes to spinnerets, and two white dots, one on each band, on the posterior part of the abdomen. Clypeus covered with white and rufus hairs; a reddish band extending from each anterior lateral eye downward to the lower border. Falces brown with fringes of white hairs on the inner borders. Mouthparts dark brown. Sternum and coxæ light brown. Venter black with a white band on each side. Palpi and legs light brown (legs of the first pair darkest) with white hairs and black spines.

Habitat: Florida, Guatemala, New Grenada (from collection of Count Keyserling), Europe, North Africa, India, Malay Archipelago, Australia, Madagascar.

HOMALATTUS (White) 1841.

Cephalothorax rather low, as wide as long, flat above, a little contracted in front, the contraction beginning opposite the dorsal eyes, and truncated in front and behind, where it is hollowed to receive the anterior margin of the abdomen. Sides gently rounded. Cephalic part occupying about two-thirds of cephalothorax, not separated from thoracic part. Thoracic part level in the first half and then falling abruptly; this slanting portion being concealed by the overlapping abdomen gives the cephalic part, when looked at from above, an appearance of exaggerated length. Quadrangle of eyes much wider behind than in front, and, behind, one-third wider than long. First row of eyes straight or slightly curved; middle eyes near together; lateral one-half as large, and separated from the middle eyes, sometimes by more than one-half their own diameter. Eyes of second row at least twice as far from dorsal as from lateral eyes. Dorsal eyes as large as lateral, much further from each other than from lateral borders (often twice as far), forming a row as wide as cephalothorax at that place. Clypeus from one-fourth to one-half as high

as middle eyes. Maxillæ enlarged at extremity. Labium one-half as long, sometimes as wide as long, sometimes longer than wide. Sternum longer than wide, sometimes truncated in front, projecting between anterior coxæ. Anterior coxæ separated sometimes by more, sometimes by less, than width of labium.

The genus *Homalattus* is nearest *Ballus* from which it is not readily distinguished. The greater length of the cephalic part (two-thirds of cephalothorax instead of one-half as in Ballus) and the shape of the thoracic part enable one to decide. *Ballus* has the thoracic part contracted and the dorsum falling gently from the dorsal eyes; in *Homalattus* the sides are not contracted, and the fall, which does not begin at the dorsal eyes, is very abrupt. In *Zygoballus* the cephalothorax is very high and the thoracic part falls steeply from the dorsal eyes. *Rhanis* C. K., *Rhene* Thorell, and *Rhene* Tacz. are identical with *Homalattus* W.

HOMALATTUS CYANEUS Hentz.

Plate I, figure 64. Plate VI, figures 64, 64a.

Syn.: 1845. Attus *cyaneus* Hentz, Journal Bost. Soc. Nat. Hist., Vol. V.
1848. Maevia *chrysea* C. Koch, Die Arachn., XIV, p. 83.
1875. Attus *cyaneus* Hentz, Coll. Arachn. Writ. by N. M. Hentz ed. by Burgess, Boston, p. 69.
1885. Homalattus *septentrionalis* Keys., Neue Spinnen aus Amerika, VI, Verhandl. zool. bot. Gesel. in Wien, p. 29 (515).

♂. Total length 4.8 mm. Width of abdomen 1.2 mm.

Cephalothorax: length 1.8; width 1.5; height .7.

Legs 3.1, 2.2, 2, 2.5; patella and tibia of the first, 1.4; patella and tibia of the third, 8; patella and tibia of the fourth, 1; metatarsus and tarsus of the fourth, 1.

♀. Total length 4.6 mm. Width of abdomen 2.3 mm.

Cephalothorax: length 1.8; width 1.7.

Legs 3, 2.2, 2.4, 3.2; patella and tibia of the first, 1.2; patella and tibia of the third, 8; patella and tibia of the fourth, 1.1; metatarsus and tarsus of the fourth, 1.

Quadrangle of eyes barely one-third wider than long. First row of eyes straight. Anterior lateral separated from middle eyes by one-half their own diameter. Eyes of second row very small, and placed fully twice as far from dorsal as from lateral eyes. Clypeus one-half as high as middle eyes. Falces as wide as first row of eyes, one and one-half times as long as face, vertical, parallel, anterior surface plane. Maxillæ truncated. Labium one-half as long as maxillæ, about as wide as long, contracted and rounded at tip. Sternum oval, nearly

twice as long as wide. Anterior coxæ separated by about the width of the labium. First leg with femur, patella and tibia enlarged. Femoral, tibial and metatarsal spines on the four pairs.

Coloration. Our specimens are somewhat damaged: the ♂ has the scales all rubbed off and appears entirely black excepting some yellowish hairs on the clypeus, and pale rings on the metatarsi of the second, third and fourth legs. On the cephalothorax and abdomen of the ♀ there are left a few yellowish white, somewhat metallic scales; otherwise it is like the ♂. Hentz describes this species as brassy-green.

Count Keyserling has kindly sent us a specimen of his *H. septentrionalis* and we find it identical with *cyaneus.*

Habitat: Iowa, New York, Pennsylvania, Massachusetts, North Carolina, Alabama, Georgia, Nebraska.

BALLUS YOUNGII Nov. Sp.

Plate I, figure 66. Plate VI, figures 66, 66a, 66b.

♂. ♀. Total length 2.8 mm. Width of abdomen 1.4 mm.

Cephalothorax: length 1.5; width 1.2; height .6.

Legs 1.9, 1.7, 1.6, 2.1. Cephalothorax a little longer than patella and tibia of the first; patella and tibia of the third shorter than patella and tibia of the fourth; patella and tibia of the fourth longer than metatarsus and tarsus of the fourth.

Cephalothorax low, plane, a very little dilated behind middle, with sides vertical in front and slightly rounded behind; cephalic part not inclined; thoracic part not slanting until it reaches the posterior border, where it is truncated and a little hollowed. Ocular area occupying nearly one-half cephalothorax, one-third wider than long, slightly wider behind than in front. Anterior eyes touching, in a straight row; middle twice as large as lateral eyes; eyes of second row halfway between lateral and dorsal eyes; dorsal as large as lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus much inclined backward, two-thirds as high as middle eyes. Falces very weak, about as long as face, parallel, inclined backward; fang very weak. Maxillæ parallel, short, wider and truncated at extremity. Labium short, twice as wide as long, rounded. Sternum oval, rather short. nterior coxæ separated by width of labium; coxæ of the fourth touching. Legs of the first and second pairs stoutest, with femoral joints compressed; inferior rows of spines on the tibiæ and metatarsi of the four pairs. Anterior end of abdomen fitting into excavation at pos terior end of cephalothorax.

Coloration: Cephalothorax, clypeus, abdomen and venter black, thinly covered with short yellow hairs; on the abdomen the thickening of these hairs forms two yellow spots on the anterior part, and three transverse yellow bands. Falces, mouthparts, sternum and coxæ light brown. Palpi and legs brown with some short yellow hairs.

The following remarks are from a letter written by Col. John J. Young, of Allegheny, Pa., to whom we are indebted for this species:

"These spiders are found at this season (November) under the bark of trees, usually hickory and sycamore. You will note that the general color of the spider corresponds with the rusty brown of the under side of the bark of the shag-bark hickory when first pulled off. In that hibernating locality it covers itself with a thin bluish envelope. The spider is so nearly of the bark color, and so small that we would often overlook the speck in the centre of the envelope, supposing it to be merely the empty tube or cell of some young spider."

Habitat: Pennsylvania.

NEON NELLII Nov. Sp.

Plate I, figure 65. Plate VI, figure 65.

♂. Total length 2.5 mm. Width of abdomen 1.2 mm.

Cephalothorax: length 1.3; width .9; height .5.

Legs —, 1.8, 2.1, 2.9.

♀. Juv. legs 4, 3, 1, 2.

Cephalothorax not high, convex, a little contracted behind dorsal eyes, sides nearly vertical in front, rounded behind; cephalic part much inclined; thoracic part sloping from just behind dorsal eyes. Ocular area occupying more than one-half cephalothorax, less than one-fifth wider than long, equally wide in front and behind. First row of eyes straight, all four touching; lateral one-half as large as middle eyes; eyes of second row a little nearer lateral than dorsal eyes; dorsal larger than lateral eyes, further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus slightly inclined, about one-fourth as high at middle eyes. Falces not as wide as two middle eyes, short, parallel, vertical; fang very weak. Maxillæ nearly parallel, rather long, rounded; labium wider than long, about one-third as long as maxillæ. Sternum convex, triangular, truncated in front. Anterior coxæ separated by more than width of labium. First legs stoutest; femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax brown, darkest in eye region. Abdomen brown with pale spots and chevrons. Palpi and legs pale with black rings; first legs darkest; remaining parts dark brown or black.

This species agrees with the genus *Neon* as defined by Simon, excepting that all the legs are spined.

Habitat: Pennsylvania, Canada (Collection of J. B. Tyrrell.)

ZYGOBALLUS SEX-PUNCTATUS Hentz.

Plate I, figure 67. Plate VI, figures 67, 67a.

Syn.: 1844. Attus *sex-punctatus* H., Journal Bost. Soc. Nat. Hist., Vol. IV.
1875. " " id., Coll. Arachn. Writ. by N. M. Hentz. Ed. by Burgess, p. 54.

Total length 3 mm. Width of abdomen .8 mm.

Cephalothorax: length 1.8; width 1.6; height .8.

Legs 3.7, 2.2, 2, 3.

Cephalic part growing wider to the dorsal eyes; general appearance from above quadrangular, with projecting corners behind dorsal eyes; dorsal eyes placed on sides, below dorsum, forming a row wider by the amount of their projection than the cephalothorax at that place. Middle anterior eyes touching, lateral sub-touching; dorsal as large as lateral eyes. Labium two-fifths as long as maxillæ, as wide as long. Metatarsi of the third and fourth legs with only terminal circles of spines.

Coloration: Cephalothorax black with a spot of white hairs in front of each dorsal eye, and one between the dorsal eyes. Clypeus black, thinly covered with white hairs. Abdomen black with a white basal band and six white spots, two on each side near the middle of the dorsum, and two near the apex. Palpi and falces brown. Legs reddish or brown, first and fourth pairs darker than second and third. Under side black, with some white hairs on sternum and venter.

Habitat: North Carolina, Georgia, Florida.

ZYGOBALLUS BETTINI Nov. Sp.

Plate I, figures 68, 68a. Plate VI, figures 68, 68a, 68b.

♂. Total length 4.2 mm. Width of abdomen 1.7 mm.

Cephalothorax: length 1.8; width 1.3; height 1.3.

Legs 4.9, 3.3, 3, 4.4.

♀. Total length 4.4 mm. Width of abdomen 2 mm.

Cephalothorax: length 1.8; width 1.4; height 1.1.

Legs 4.4, 3.2, 3, 4.5.

Clypeus inclined backward. Falces (♂) nearly as wide as first row of eyes, twice as long as face, inclined forward, diverging; fang long; (♀) extending only to inner edges of lateral eyes; one and one-half times as long as face, vertical, parallel; fang small. Maxillæ (♂) widest in middle, blunt at tip, cut obliquely on inner side; (♀) a little widest at extremity, rounded. Labium one-half as long as maxillæ, (♂) longer than wide, (♀) as wide as long. Legs without patellary spines, excepting one on the first leg, (♂) coxæ and trochanter of the first elongated.

Coloration: ♂. Cephalothorax bronze brown; eye region covered with reddish gold metallic scales; anterior faces of falces, clypeus and sides of cephalothorax as far back as second row of eyes, covered with white scale-like hairs. Abdomen bronze, with a silvery white band passing around base and downward onto the sides; a second white band, on each side, curves over the side from the upper to the under surface, and on the posterior dorsum are two more short curved white bands, these last being semi-circular in form. Mouth-parts, sternum and venter brown. First leg with elongated coxa and trochanter, as well as the femur, dark mahogany color; the other joints and all the other legs yellowish white.

♀. Cephalothorax bronze brown with metallic scales on eye region as in ♂. Anterior eyes surrounded by rings of reddish yellow hair. Abdomen brown; a white band passes around the base and extends on to the sides; beyond the termination of this are two short white bars on each side; on the anterior half of the dorsum is a wide longitudinal band composed of reddish golden scales; the posterior edge of this band is notched. Behind the band are two chevrons of the same scales, and two short bands, one on each side of the spinnerets; two black spots are found in front of the first, and two more behind the second chevron. Femur of the first leg mahogany color; other joints and all the other legs white with some dark rings and spots.

Habitat: Wisconsin, Missouri, Georgia, Florida

AGOBARDUS ANORMALIS Keyserling.

Plate I, figure 69. Plate VI, figure 74.

1885. Agobardus *anormalis* Keys., Neue Spinnen aus Amerika, VI, Vernandl. zool. bot. Gesel. in Wien, p. 33 (519).

♂. Total length 4.7 mm. Width of abdomen 1.4 mm.

Cephalothorax: length 2.6; width 2.

Legs 6.7, 4.9, 5.5, 5.6; patella and tibia of the first, 2.3; patella and tibia of the third, 1.9; patella and tibia of the fourth, 1.9; metatarsus and tarsus of the fourth, 2.

♀. Total length 4.6 mm. Width of abdomen 1.7 mm.

Cephalothorax: length 2.1; width 1.6.

Legs 3.8, 3.3, 4.6, 4.8; patella and tibia of the first, 1.4; patella and tibia of the third, 1.6; patella and tibia of the fourth, 1.8; metatarsus and tarsus, 1.7.

Cephalothorax very high at dorsal eyes but, in front, not higher than clypeus and lateral eye, on account of the steep inclination of the cephalic part. Sides nearly parallel, a very little dilated in the middle, vertical in front, rounded behind; thoracic part falling steeply from dorsal eyes. Quadrangle of eyes occupying one-half of cephalothorax, twice as wide as long, equally wide in front and behind. First row of eyes much bent; middle eyes sub-touching; lateral a little more than one-half as large, separated from them by one-half their own diameter. Eyes of second row a very little nearer lateral than dorsal eyes. Dorsal as large as lateral eyes, equally distant from each other and the lateral borders, forming a row as wide as cephalothorax at that place. Clypeus one-fifth as high as middle eyes. Falces extending to inner edges of lateral eyes, one and one-half times as long as face, inclined backward, a little diverging; fang weak. Maxillæ slightly diverging, enlarged and rounded at extremity. Labium one-half as long as maxillæ, as wide as long. Sternum nearly as wide as long, oval, projecting between anterior coxæ. Anterior coxæ separated by nearly the width of the labium. Legs of the first pair a little stoutest. Femoral, patellary, tibial and metatarsal spines on the four pairs; those on metatarsi of the fourth extending to base.

Coloration: Cephalothorax brown with a lighter central longitudinal band in thoracic part, in the midst of which is a spot of white hairs; the eyes are placed in black spots; the anterior part of the cephalic plate, the lower sides, and the clypeus are covered with white hairs; the lower margin is black. Abdomen brown, with a curved white basal band and a central wide white longitudinal band which is often indistinct in the anterior part, and is interrupted behind by a slender brown transverse curved band; this middle band gives off on either side two short white spots which are longer than wide, one in the middle of the first half, the other, oblique, just in front of the spinnerets. Venter dark brown or black with a white band behind and on the sides. Palpi yellowish brown excepting the last two joints which are black, with black hairs. Falces, mouthparts, sternum coxæ and legs reddish brown.

Habitat: United States.

ATTUS CAUTUS Nov Sp.

♂ Juv. Total length 4.5 mm. Width of abdomen 1.6 mm.

Cephalothorax: length 2, width 1.5; height 9.

Legs 3, 3.2, 3.7, 4. Cephalothorax much longer than patella and tibia of the first; patella and tibia of the third shorter than patella and tibia of the fourth; patella and tibia of the fourth and metatarsus and tarsus of the fourth equal.

Cephalothorax moderately high, slightly convex, a little contracted behind, with sides vertical in front and rounded behind; cephalic part slightly inclined; thoracic falling gradually in the first two-fifths, then steeply. Ocular area occupying nearly one-half cephalothorax, one-third wider than long, equally wide in front and behind. Anterior eyes sub-touching, in a slightly curved row, the middle twice as large as the lateral eyes; eyes of second row halfway between lateral and dorsal eyes: dorsal as large as lateral eyes, a little further from each other than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus inclined backward, one-third as high as middle eyes. Falces as wide as the two middle eyes, as long as face, vertical, parallel. Maxillæ enlarged and blunt at extremity, parallel. Labium two-thirds as long as maxillæ, perhaps a little longer than wide, contracted and rounded at tip. Sternum one-fourth longer than wide, truncated in front. Anterior coxæ separated by more than width of labium. Legs of the first and second pairs slightly stoutest: femoral, tibial and metatarsal spines on the four pairs; metatarsi of the fourth spined throughout their length.

Coloration: Cephalothorax black with lower sides white, a white band above anterior eyes, another behind dorsal eyes, and a white spot in the middle of the cephalic part. Clypeus and falces covered with white hairs. Abdomen with the anterior third and the apex black, while the remaining portion is covered with bright yellowish brown hairs; there are four transvere white bands; two cross the anterior black region, one the brown region, and one separates the brown from the black region at the apex. Palpi light brown with thin white hairs. Mouthparts and coxæ light brown or pale. Sternum dark brown. Venter brown with a whitish longitudinal band on each side. Legs brown with blackish bands and some short white hairs.

Not wishing to found a new genus upon an immature specimen we put this species in the genus *Attus* Walck.

Habitat: Mexico.

SYNEMOSYNA (Hentz) 1832.

Cephalothorax low, twice as long as wide, rounded and narrower behind; thoracic and cephalic part not separated: thoracic part plainly divided by two transverse constrictions and much longer than cephalic — sometimes twice as long. Quadrangle of eyes but little wider than long and a little wider behind than in front. First row of eyes a little curved; middle eyes touching, and three times as large as lateral eyes, from which they are slightly separated. Eyes of second row small and a little nearer lateral than dorsal eyes. Dorsal eyes larger than lateral and further from each other, than from lateral borders, forming a row as wide as cephalothorax at that place. Clypeus about one-fourth as high as middle eyes. Falces short, rather weak, vertical, parallel; fang weak. Maxillæ slightly enlarged and truncated at extremity, about twice as long as labium. Labium as wide as long, rounded. Sternum long, rather narrow, truncated in front, contracted behind, projecting between anterior coxæ. Anterior coxæ separated by at least the width of the labium at its base. Legs (♂) 4, 1, 3, 2, (♀) 4, 3, 1, 2, all slender; tibiæ and metatarsi of the first and the second, with two rows of inferior spines. Abdomen long, rounded, slender, with a marked constriction; pedicle of abdomen visible from above. *Synemosyna* differs from the other genera of ant-like Attidæ, in the following respects: *Synageles* Sim., *Leptorchestes* (Thorell) Sim., *Damœtas* Peckham, all have the quadrangle of the eyes longer than wide, and the constriction of the cephalothorax wanting, or, if present, very slight, and separating the cephalic and thoracic parts. *Agorius* Thorell has the patella of the first leg much elongated. *Paradamoetas* Peckham has no constriction of the cephalothorax. The last two genera resemble *Synemosyna* in having the quadrangle a little wider than long. It is nearest *Salticus* (Latr.) Sim.; *Salticus*, however, has the cephalic part on a higher plane than the thoracic, and the greater length of the maxillæ, and the labium being much longer than wide also distinguish it from *Synemosyna*.

SYNEMOSYNA FORMICA Hentz.

Plate VI, figures 70, 70a.

Syn.: 1845. Synemosyna *formica* H., Journal Bost. Soc. Nat. Hist., Vol. V.
1846. Janus *gibberosus* C. K., Die Arachniden, XIII, p. 21.
1875. Synemosyna *formica* H., Coll. Arachn. Writ. by N. M. Hentz. ed. by Burgess, Boston, p. 73.
1883. Synemosyna *formica* Peckham, Descr. new or little known Attidæ of U. S., p. 30.

♂. Total length 3.9 mm. Width of abdomen 7mm.

Cephalothorax: length 1.8; width .8; height .7.

Legs 3, 2.2, 2.5, 3.2; patella and tibia of the first, 1; patella and tibia of the third, .9; patella and tibia of the fourth, 1.3; metatarsus and tarsus of the fourth, 1.2.

♀ Total length 5.4 mm. Width of abdomen 1.8 mm.

Cephalothorax: length 2.2; width .7; height .8.

Legs 2.7, 2.2, 2.8, 3.5; patella and tibia of the first, 1; patella and tibia of the third, 1.1; patella and tibia of the fourth, 1.7; metatarsus and tarsus of the fourth, 1.5.

Cephalothorax with one constriction a little way behind the dorsal eyes, and another just in front of the juncture of the thoracic part with the abdominal pedicle; abdomen with a deep constriction before the middle, posterior to which it is enlarged and rounded.

Coloration: Cephalothorax brown, lighter on the upper surface, sometimes blackish on the sides, smooth, glabrous, with a few short white hairs in the eye region; abdomen in front of the constriction pale rufus, with a darker longitudinal band on the upper surface; behind the constriction b ack with a pale band, which is narrow in the ♂, but in the ♀ is wider, occupying the anterior sides and curving downward under the venter; clypeus blackish; falces black with pale edges; maxillæ and labium black, edged with white; sternum pale anteriorly, blackish behind; venter pale in front, black toward apex. Legs of the first pair pale with an internal and external black line on the femur, patella and tibia; second all pale; third pale, excepting femur, which is light rufus; fourth femur rufus, patella pale at proximal. blackish at distal end, tibia proximal end blackish, shading into pale toward metatarsus, metatarsus and tarsus pale.

Habitat: United States.

SYNAGELES PICATA Hentz.

Plate VI, figure 71.

Syn.: 1845. Synemosyna *picata* H., Journal Bost. Soc. Nat. Hist. Vol. V.
1875. " " id., coll. Arachn. Writ by N. M. Hentz, ed. by Burgess, Boston, p. 75.

♀. Total length 4.2 mm. Width of abdomen 1.5 mm.

Cephalothorax: length 2; width .9; height .7.

Relative length of legs 4, 3, $\overline{1, 2}$.

Ocular area occupying a little more than one-half of cephalothorax, plainly longer than wide, and a little wider behind than in front. Anterior row of eyes very slightly curved; lateral less than one-half as large

as middle eyes, and slightly separated from them; eyes of second row twice as far from dorsal as from lateral eyes; dorsal eyes further from each other than from lateral borders. Clypeus fully one-half as high as middle eyes, vertical. Falces extending in width to inner edges of lateral eyes, a little longer than face, vertical, parallel. Maxillæ enlarged and blunt at extremity; labium semi-circular. Sternum twice as long as wide, contracted in front and behind. Anterior coxæ separated by scarcely the width of the labium. Abdomen with a constriction in front of the middle.

Coloration: Eye-region black with violet reflections; thoracic part reddish-brown with a short, transverse white band behind dorsal eyes. Anterior segment of abdomen reddish-brown; posterior segment glistening black with two white bands which begin at the constriction and curve downward over the sides. Venter with a semi-circular greenish-yellow spot behind the epigynum.

Habitat: North Carolina, Alabama, Wisconsin.

SYNAGELES SCORPIONA Hentz.

Plate VI, figures 72, 72a.

Syn: 1845. Synemosyna *scorpiona* H., Journal Bost. Soc. Nat. Hist., Vol. V.

1875. " " id., Coll. Arachn. Writ. by N. M. Hentz, ed. by Burgess, Boston, p. 74.

♂. Total length 2.4 mm. Width of abdomen 5 mm.

Cephalothorax: length 1; width, 8; height, 4.

Legs 2, 1.5, 1.5, 2.6.

♀. Total length 3.5 mm. Width of abdomen 1.2 mm.

Cephalothorax: length, 1.4; width, 8; height, 5.

Patella and tibia of the first, 1; patella and tibia of the third, 8; patella and tibia of the fourth, 1.1; metatarsus and tarsus of the fourth, 8.

Ocular area occupying nearly two-thirds of the cephalothorax, a little more than one-third longer than wide, and wider behind than in front. Anterior row of eyes very slightly curved, lateral about one-half as large as middle eyes and separated from them by one-fourth their own diameter; eyes of second row not quite twice as far from dorsal as from lateral eyes; dorsal eyes further from each other than from lateral borders. Clypeus, (♂) less than one-half, (♀) one-half as high as middle eyes, vertical. Falces as wide as the two middle eyes, about as long as the face, vertical, parallel. Maxillæ rather long, a little enlarged at extremity, (♂) truncated, (♀) rounded; anterior coxæ separated by more than the width of labium. First legs a little the stoutest, dark.

Coloration: ♂. Cephalothorax brown; abdomen brown anteriorly, encircled by a white line in front of middle, behind which it is blackish; other parts brown excepting a pale spot on the anterior part of the venter. ♀. Cephalothorax brownish with the eyes on black spots; abdomen pale with two short, curved, dark bands near the spinnerets; falces brownish, venter pale with a dark region near the spinnerets; legs brown above, pale beneath; other parts all pale.

Habitat: New York, Ohio, North Carolina.

SALTICUS EPHIPPIATUS Hentz.

Plate VI, figure 73.

Syn.: 1845. Synemosyna *ephippiata* H., Journal Boston Soc. Nat. Hist. Vol. V.

1846. Salticus *albocinctus* C. K., Die Arachinden, XIII, p. 36.

1875. Synemosyna *ephippiata* H., Coll, Arachn, Writ. by N. M. Hentz. Ed. by Burgess, Boston, p. 74.

♂. Total length 5.2 mm. Width of abdomen 1.4 mm.

Cephalothorax: length 2.4; width 1.4; height 1.2.

Legs 5.3, 4.1, 4.5, 6.1; patella and tibia of the first, 2.4; patella and tibia of the third, 1.8: patella and tibia of the fourth, 2.6; metatarsus and tarsus of the fourth, 2.

Cephalothorax moderately high and slightly convex; sides almost parallel; ocular area very slightly wider than long, and equally wide in front and behind; anterior eyes small, in a straight row; lateral about one-half as large as middle eyes, separated from them by one-fourth their own diameter; eyes of second row halfway between lateral and dorsal eyes; dorsal nearly as large as lateral eyes, and a little nearer each other than lateral borders. Clypeus less than one-fourth as high as middle eyes. Falces wider than first row of eyes, more than three times as long as face, inclined forward, diverging; fang as long as falx. Maxillæ long, slender, blunt at tip, about twice as long as wide, parallel. Labium less than one-half as long as maxillæ, about as wide as long, blunt. Sternum narrow, and more than twice as long as wide. Anterior coxæ separated by width of labium. Legs all slender and long; tibial and metatarsal spines on the four pairs; the metatarsi of the fourth spined throughout their length. Abdomen with a constriction in front of middle.

♀ Total length 5 mm. Width of abdomen 1.2 mm.

Cephalothorax: length 2.2; width 1.2; height 1.

Legs 3.8, 3.1, 3.4, 5.3; patella and tibia of the first, 1.8; patella and tibia of the third, 1.3; patella and tibia of the fourth, 2; metatarsus and tarsus of the fourth, 2.

Clypeus one-fourth as high as middle eyes. Falces extending in width only to the inner edges of the lateral eyes, as long as the face, parallel, and slightly inclined forward; fang short. Maxillæ less than twice as long as wide. Labium more than one-half as long as maxillæ.

Coloration: Cephalothorax brownish; abdomen brown in front of constriction, black behind, encircled by a white line at the constriction; falces dark with white hairs; clypeus, mouthparts, sternum, coxæ and venter brown; legs with a tinge of yellow.

Habitat: Pennsylvania, New York, Alabama.

LYSSOMANES Hentz.

Syn.: 1844. Lyssomanes Hentz, Journal Boston Soc. Nat. Hist., Vol. IV.

Cepalothorax moderately high, sloping downward behind and on the sides from the caput, about one-third longer than wide. General form oval. Caput occupying one-half or nearly one-half of cephalothorax.

Eyes arranged in four transverse rows of two each. Eyes of first row close together, from two to three times as as large those of second row, occupying the entire face. Second row just behind first and about as wide (sometimes a little wider or narrower). Third row composed of two very small eyes, plainly nearer the second than the fourth row, narrower than the second and wider than the fourth. Eyes of fourth row about as large as those of second and nearer together; quadrangle formed by second and fourth rows as wide as long, or from one-fourth to one-third wider.

Sternum somewhat heartshaped; length and width about equal. Coxæ separated by the width of the labium and part or all of the maxillæ. Maxillæ slightly enlarged at extremities. Labium about as wide as long or a little longer than wide. Abdomen long, slender, tapering; spinnerets short. Legs usually long and slender; relative length variable. Long and slender femoral, tibial, metatarsal and usually patellary spines on the four pairs.

LYSSOMANES VIRIDIS Hentz.

Syn.: 1844. Lyssomanes *viridis* Hentz, Jour. Boston Soc. Nat. Hist., Vol. IV.

1875. " " id., Coll. Arachn. Writings. Ed. by Burgess, Boston, p. 49.

♂. Total length 6.5 mm. Width of abdomen 1.5 mm.

Cephalothorax: length 2; width 2; height 1.3.

Legs 12, 9.5, 8.5, 8; patella and tibia of the first, 4.5; patella and tibia of the third, 3; patella and tibia of the fourth, 3; metatarsus and tarsus of the fourth, 3.2. Falx 2.5.

♀. Total length 8 mm. Width of abdomen 2.4 mm.

Cephalothorax: length 3; width 2.6; height 1.8.

Legs 10.5, 9, 8.3, 8; patella and tibia of the first, 4.5; patella and tibia of the third, 3; patella and tibia of the fourth, 3; metatarsus and tarsus of the fourth, 3.4.

Coloration: Cephalothorax and abdomen light yellow; cephalothorax with a slender, central, dark, longitudinal line on the thoracic part; eyes of second and third rows on black tubercules. Abdomen with six black dots (sometimes wanting) arranged in two longitudinal rows. There are some orange colored hairs around the anterior eyes, and in the male the falces are reddish in front. The other parts are light yellow.

Hentz describes this species as being tender grass-green. The color probably changes in alcohol.

Habitat: Southern United States.

DESCRIPTION OF PLATES.

PLATE I.

1. Phidippus morsitans, ♀; 1a, epigynum.
2a. " rufus, epigynum.
3. " galathea, ♀; 3a, epigynum.
5. " obscurus ♀.
6. " minatus, ♀; 6a, epigynum.
8. " ranterbergii, ♀.
10. " arizonensis, ♂.
12. " insolens, ♀.
13. " albomaculatus, ♀.
14. " johnsonii, ♀.
15. " otiosus, ♀.
16. Philæus farneus, ♀.
17. " fartilis, ♀.
18. " mexicanus, ♀.
19. " militaris, ♀.
19a. " " ♂.
20. " chrysis, ♀.
22. " rimator, ♀.
23. Plexippus puerperus, ♂. (Figure blurred on plate.)
23a. " " ♀.

25. Dendryphantes capitatus, ♂.
25a, 25b. " " ♀, two varieties.
27. " flavus, ♀.
30. Attus palustris, ♀.
32. Icius lineatus, ♀.
33. Icius palmarum, ♀.
34. " mitratus, ♀.
35. " piraticus, ♂.
35a. " albovittatus, ♂.
36. Pseudicius harfordii, ♀.
36a. " " ♂.
37. Eris octavus, ♀.
39. " nervosus, ♀.
40. Hasarius hoyi, ♀.
40a. " " ♂.
42. Habrocestum cœcatum, ♀.
43. " viridipes, ♀.
44. " peregrinum, ♂.
45. " cristatum, ♀.
46a. " auratum, ♀.
48. " splendens, ♀.
50. Saitis pulex, ♀.
50a. " " ♂.
51. Prostheclina cambridgii, ♀.
52. Astia vittata, ♀.
52a. " " ♂.
53. Astia morosa, ♀.
55. Cytæa minuta, ♀.
56. Cyrba tæniola, ♀.
57. Epiblemum scenicum, ♀.
58. Admestina wheelerii, ♂.
59. Hyctia pikei, ♂.
60. Marptusa familiaris, ♀.
61. " californica, ♀.
62. Menemerus melonagnathus, ♂.
62a. " " ♀.
63. " paykulli, ♀.
64. Homalattus cyaneus, ♂.
65. Neon neelii, ♂.
66. Ballus youngii, ♀.
67. Zygoballus sexpunctatus, ♂.
68. " bettini, ♀.
68a. " " ♂.
69. Agobardus anormalis, ♀.
70. Sadala distincta, ♂.

PLATE II.

1. Phidippus morsitans, ♂ palpus.
2. " rufus, ♂ palpus.
4. " cardinalis, ♂ palpus
5 " obscurus epigynum.
7. " mexicanus, ♂ palpus.
8. " rauterbergii, epigynum.
9. " mc 'cookii, epigynum.
10. " arizonensis, ♂ palpus.
11. " opifex, epigynum.
12. " insoleus, palpus of ♂; 12a epigynum.
13. " albomaculatus, epigynum.
14. " johnsonii, palpus of ♂; 14a epigynum.
15. " octopunctatus, ♂ palpus.
15a. " otiosus, epigynum.
16. Philæus farneus, epigynum.
17. Philæus fartilis, epigynum.
18. " mexicanus, epigynum.
19. " militaris, palpus of ♂; 19a epigynum.
20. " chrysis, ♂ palpus.
23. Plexippus puerperus, ♂ palpus; 23a, tibia of ♂ palpus. For epigynum see Plate III, fig. 23b.

PLATE III.

20a. Philæus chrysis, epigynum; —aurecalceus = chrysis.
21. " princeps, epigynum.
23b. Plexippus puerperus, epigynum.
24. " putnamii, ♂ palpus.
25. Dendryphantes capitatus, palpus of ♂; 25a, epigynum.
26. " elegans, palpus of ♂; 26a, epigynum; 26b, first leg of ♂. For mouthparts and falces of ♀ see Plate IV, fig. 26c.
27. Dendryphantes flavus, epigynum; 27a, mouthparts and falces of ♀.
28. Dendryphantes multicolor, epigynum; 28a mouthparts and falces of ♀.
29. Dendryphantes alboimmaculatus, epigynum.
29a. " flavipedes, ♂ palpus.
30. Attus palustris, palpus of ♂; 30a, epigynum.
31. " imperialis, ♂ palpus; 31a, mouthparts and falces of ♂.
32. Icius lineatus, ♂ palpus; 32a, same, from one side; 32b, epigynum.

33. Icius palmarum, palpus of ♂; 33a, epigynum.
34a. " mitratus epigynum. For ♂ palpus see Plate IV, fig. 34.
36. Pseudicius harfordii, epigynum. For ♂ palpus see Plate IV, figure 36a.
37. Eris octavus, epigynum.
39. " nervosus, epigynum.

PLATE IV.

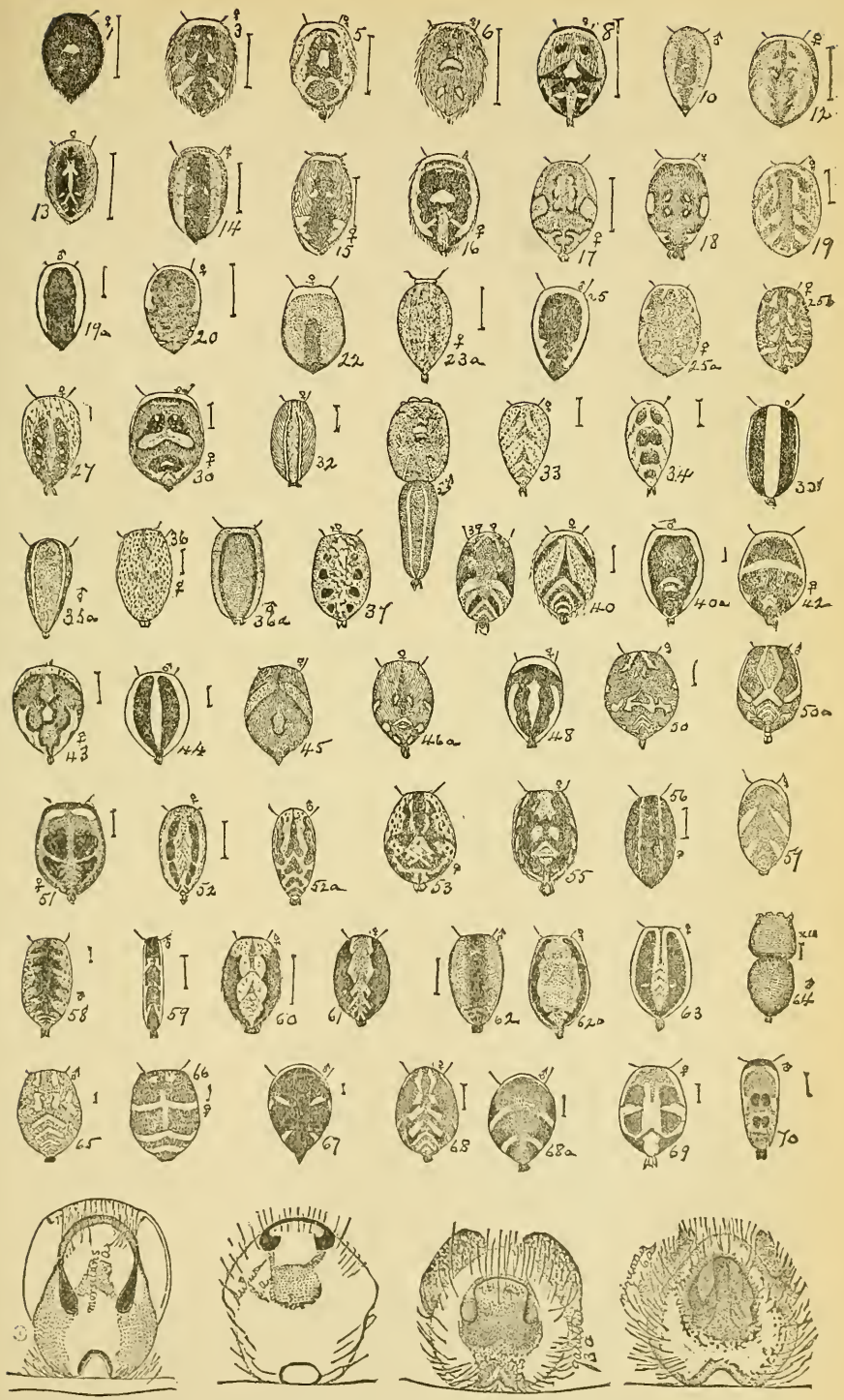
26c. Dendryphantes elegans, falces and mouthparts of ♀.
34. Icius mitratus, ♂ palpus.
35. " piraticus, ♂ palpus; 35a, same from outer side.
35d. " albovittatus ♂ palpus.
36a. Pseudicius harfordii, ♂ palpus.
38. Eris barbipes, epigynum; 38a, first leg of ♀.
40. Hasarius hoyi ♂ palpus; 40a, epigynum.
42. Habrocestum cœcatum, palpus of ♂; 42a, epigynum; 42b, third leg of ♂ from behind.
43. Habrocestum viridipes, ♂ palpus; 43a, epigynum.
44. " peregrinum ♂ palpus; 44a, patella of third leg of variety 1; 44b, same of variety 2.
45. " cristatum, epigynum.
46. " auratum, epigynum; 46a, ♂ palpus; 46b, mouthparts and falces of ♂.
47. " hirsutum, first leg of ♂; 47a, ♂ palpus.

PLATE V.

48. Habrocestum splendens, ♂ palpus; 48a, epigynum.
49. " oregonense, ♂ palpus; 49a, first leg of ♂.
50. Saitis pulex, epigynum; 50a, ♂ palpus.
51. Prostheclina cambridgii, ♂ palpus; 51a, epigynum.
52. Astia vittata, ♂ palpus; 52a, epigynum.
53. " morosa, ♂ palpus; 53a, epigynum.
54. Maevia californica, ♂ palpus; 54a, mouthparts and falces.
55. Cytæa minuta, ♂ palpus; 55a, epigynum.
56. Cyrba tæniola, ♂ palpus; 56b, mouthparts and falces of ♀. For epigynum see Plate VI, fig. 56a.
58 Admestina wheelerii, ♂ palpus.
59. Hyctia pikei, ♂ palpus. For epigynum see Plate VI, fig. 59a.
60. Marptusa familiaris, ♂ palpus. For epigynum, see Plate VI, fig. 60a.
61. " californica, ♂ palpus. For epigynum, see Plate VI, fig. 61a.

PLATE VI.

56a. Cyrba tæniola, epigynum.
57. Epiblemum scenicum, epigynum.
59a. Hyctia pikei, epigynum.
60a. Marptusa familiaris, epigynum.
61a. " californica, epigynum.
62. Menemerus melanognathus, ♂ palpus; 62a, epigynum.
63. " paykullii, ♂ palpus; 63a, epigynum.
64. Homalattus cyanens, ♂ palpus; 64a, epigynum.
65. Neon nellii, ♂ palpus.
66. Ballus youngii, ♂ palpus; 66a, same from one side; 66b, epigynum.
67. Zygoballus sexpunctatus, mouthparts and falces of ♂; 67a, ♂ palpus.
68. " bettini, ♂ palpus; 68a, epigynum; 68b, falces and mouthparts of ♂.
70. Synemosyna formica, ♂ palpus; 70a, epigynum.
71. Synageles picata, epigynum.
72. " scorpiona, epigynum; 72a, ♂ palpus.
73. Salticus ephippiatus, ♂ palpus.
74. Agobardus anormalis, ♂ palpus.
76. Sadala distincta, ♂ palpus.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morsitans 1
rubus 2
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7 mexicanus
osmunda 10
insolens 12
24 johnsonii
octopunctatus 15
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20 chrysis
43 puerperus
obscurus 5
rantenberg 8
mcvoki 9
puerperus 23 a
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militaris 19 a
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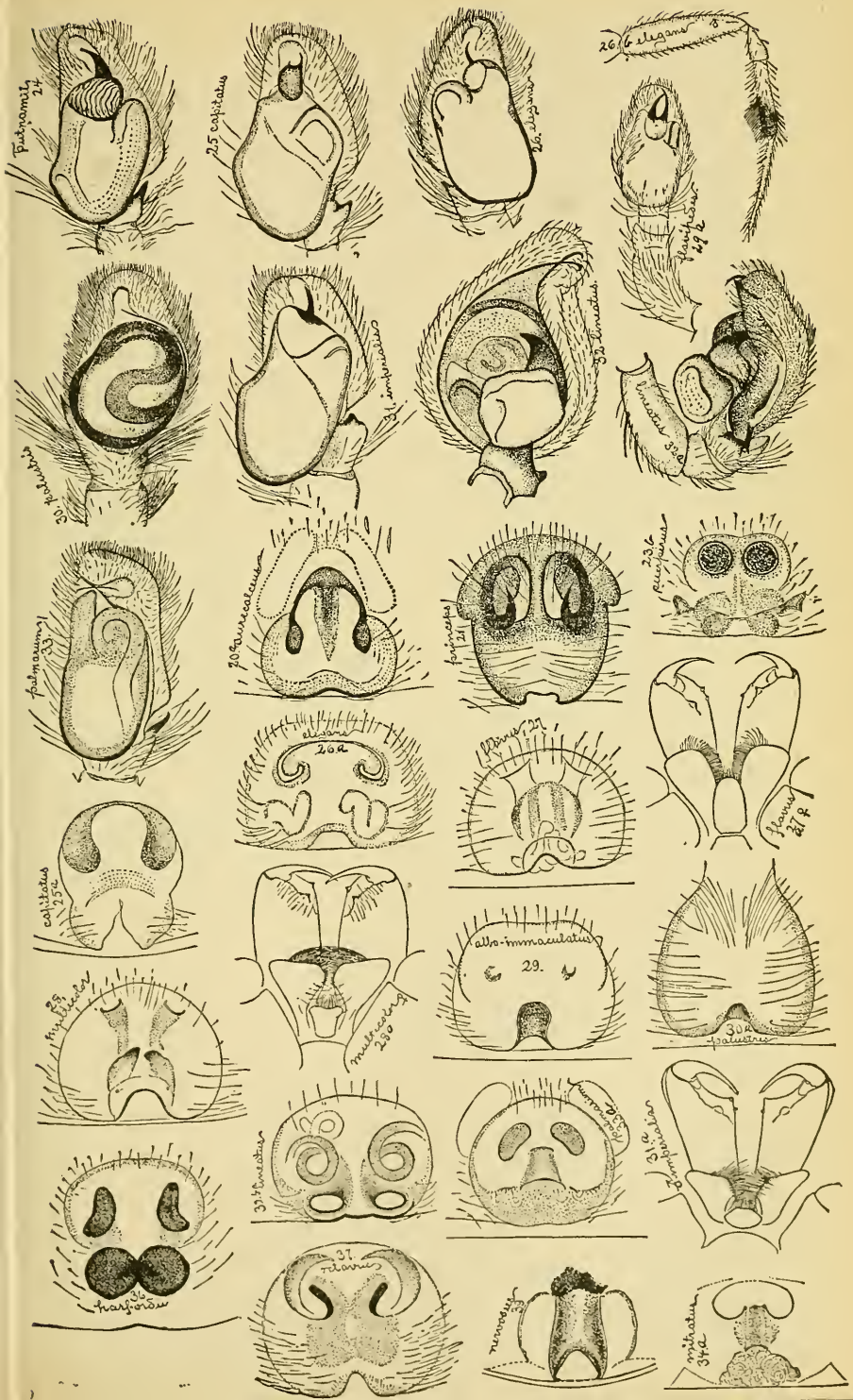
fartilis
18 mexicanus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26 b elegans
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lineatus 32 a
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princeps 21
23 b pulcherrimus
elegans 26 a
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29. multicolor
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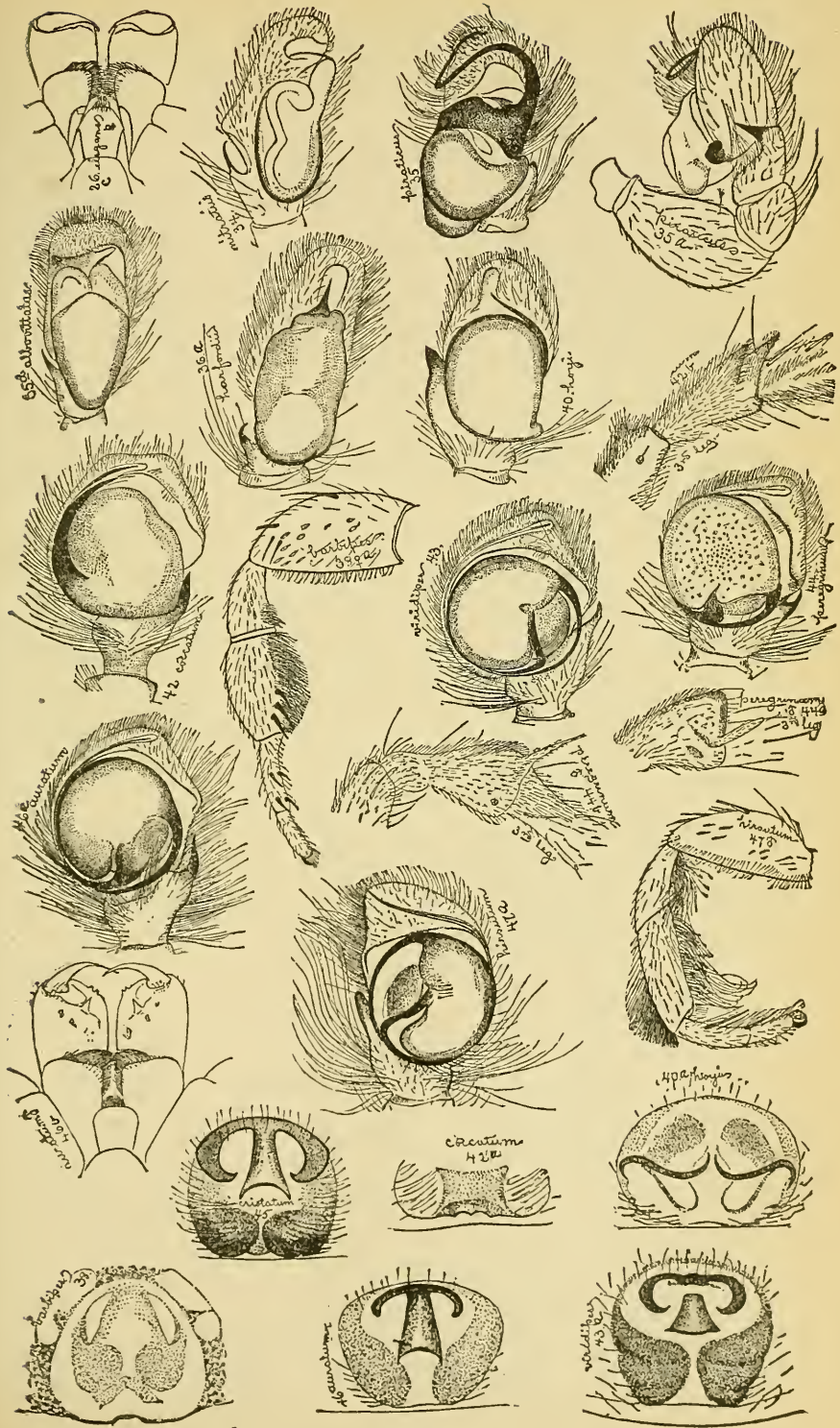
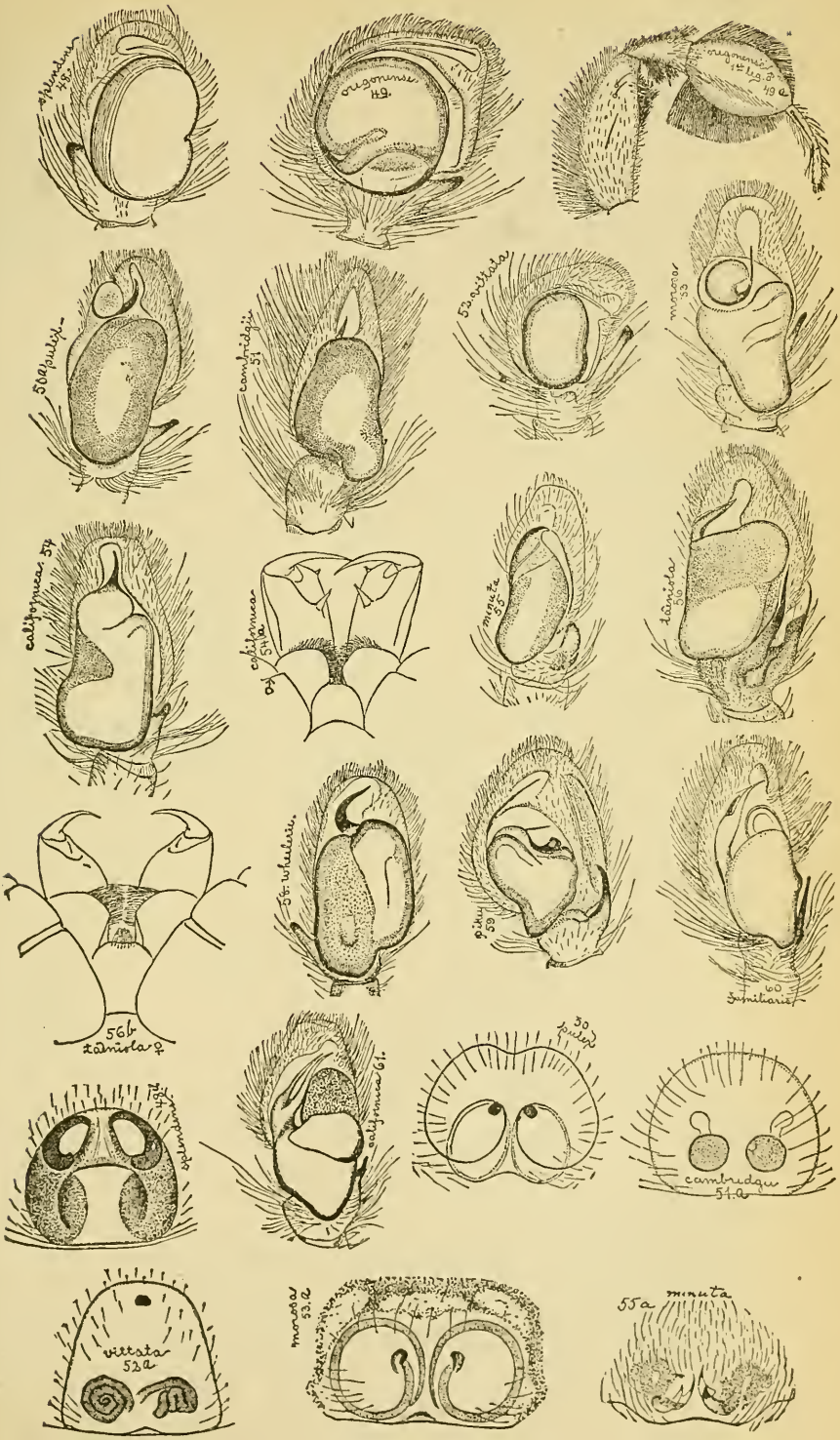
mitratus 34 a

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oregonense 49.
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56 b taeniola ♀
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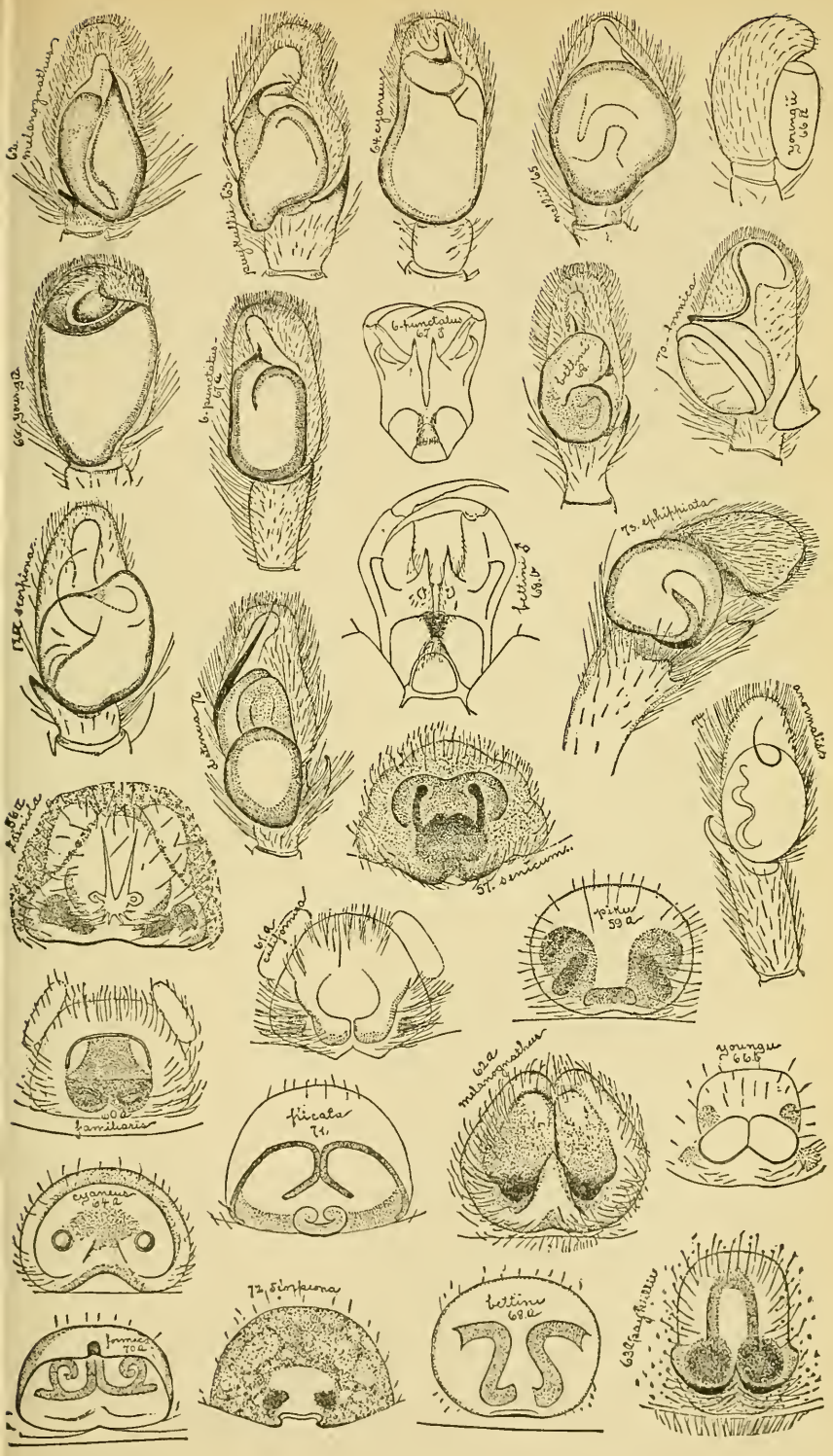
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64. cyaneus
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6. punctatus 67 a
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73. ephippiata
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57. senicum
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THE MORELS AND PUFF-BALLS OF MADISON.

By WILLIAM TRELEASE.

To facilitate the work of collectors engaged with the cryptogamic botany of the state, a preliminary list of the parasitic fungi of Wisconsin was presented to the Academy at its meeting in the winter of 1882.[1] In continuation of that list, the following descriptions of non-parasitic species are offered for publication. The groups that have been selected are not closely related, as might have been inferred from their treatment in a single paper, nor do they include many species: but they possess some general interest because the majority of the species are edible, and they derive scientific interest from the fact that their discrimination is attended with considerable difficulty.

Several correspondents have favored me with their collections for study, and I am under especial obligation in this respect to Dr. J. J. Brown of Sheboygan. The names that have been adopted rest upon a comparison of our specimens with the rich collections of Professors C. H. Peck, of the New York State Museum, and W. G. Farlow, of Harvard University, the latter of which includes the Curtis herbarium, and hence contains types of the species of Berkeley and Curtis, described in Grevillea. My thanks are also due these gentlemen for the use of papers not otherwise accessible to me, and for opinions on doubtful forms. Similar opinions have also been given by the late Dr. G. Winter, of Comrewitz, Germany, Professor P. Magnus, of Berlin, and Dr. M. C. Cooke, and Mr. George Massee, of London; but for the nomenclature adopted I am personally responsible. While it is believed that the names employed are in accordance with the opinion of the best authorities on American fungi, it is by no means certain that references to the older European names are in all instances above suspicion, for many descriptions and figures are insufficient, and the paucity of authentic specimens, as well as the poor state of preservation of some of those extant, contribute to the general uncertainty.

I. MORELS.

Order ASCOMYCETES. Sub-Order DISCOMYCETES.

The popular name of Morel corresponds to the genus *Morchella*, which comprises fleshy fungi with a rather stout hollow stem, bearing at the top a dilated round or conical head, reticulated by prominent ridges that sepa-

[1] Transactions, vi, 106. Reprints of the paper were issued early in November 1884, in advance of the volume.

rate coarse depressions. This head, or pileus, is covered externally by elongated sterile bodies (paraphyses) and oblong spore-sacs (asci), both microscopic. In our species the asci contain eight ellipsoidal spores each; but others are known in which only two spores are found in each ascus.— The two species that have been collected about Madison are distinguished by the character of the pileus.

Pileus aduate to the stipe, coarsely pitted..... *M. esculenta.*
Pileus free, at least for its lower half, longitudinally ribbed..... *M. hybrida.*

1. MORCHELLA ESCULENTA (Mich.)— Stipe stout, somewhat mealy or furfuraceous. Pileus variable, round to conical, regularly and coarsely pitted. Spores 10—13.5×17—23μ.— Mostly in white oak woods, in the spring. Reported in Bundy's list of Wisconsin fungi. [1]

In the commonest form the plant is two to four inches high, with the stipe and pileus of nearly equal length; the latter oblong, obtuse, and not much dilated. Another type, which is not uncommon, is rather shorter, with the pileus considerably dilated and nearly spherical. In a less frequent form it is elongated and decidedly conical. All are found in open dry woods, and are most abundant under or near white oak trees (*Quercus alba*).[2]

Occasionally they are found in meadows, and I once collected a number of unusually large specimens on the side of a high, gravelly railroad embankment, in company with *Equisetum arvense*, entirely removed from trees of any kind. Young specimens, with an elongated smoky pileus, the tops of the ridges only being pale, agree with var. *cylindrica* as figured by Vittadini [3] who recognized it as an immature state.

Figures: — Cooke, Mycographia, i, pl. 81, f. 312. *Exsiccatae:* — Ravenel, Fungi Carol, i. no. 36; Ellis, N. A. Fungi, no. 979.

Other similar species referred to by writers on American fungi are *M. crassipes* Fr. (Bull. Washburn Laboratory, i, 70), *M. elata* Fr. (Grevillea, iii, 149; Bull. Buffalo Soc., ii, 286), *M. deliciosa* Fr. (30 Rep. N. Y. Museum, 58), and *M. conica* P. (Mycographia, i. pl. 81, f. 315; Cat. Pac. Coast fungi, 33; Bull. Washburn Lab. i. 70.— *M. esculenta*, var. *conica* of Bull. Buffalo Soc. ii, 286 and Curtis, Catalogue, 131). The first two are large, the first, especially, with a much inflated stipe; the others are smaller and more delicate. Perhaps one or more of them occur among the Madison specimens, but I am unable to separate our plants by any constant or good characters.

2. MORCHELLA HYBRIDA (Sow.) P.— Stipe usually slender (one-fourth to one-half inch), furfuraceous or smoothish, with more or less red-brown transverse striation. Pileus short (three-fourths inch or less), conical or thimble

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[1] Report. Geol. Surv. Wis., Vol. 1, p. 401.

[2] Harkners and Moore speak of *M. esculenta* as growing under oaks (Cat. Pacific Coast Fungi, 33). James finds it usually under the ash (Ohio Agric. Rep., 1881, 97). According to Peck, the commonest form about Albany is found under or in the vicinity of pines (28 Rep. N. Y. Museum, 86), and Day also finds it under conifers (Cat. Buffalo Plants, 152).

[3] Descrizione dei funghi mangerecci piú communi dell' Italia, 105, note, pl. 13, f. 4-5.

shaped, its lower half free from the stipe, longitudinally ribbed but with few transverse ridges. Spores about 17×27 μ.—Damp shady woods, in spring; less common than the first.

Two species of De Candolle are included under this name: the first, *M. semilibera*, with a smooth stem; the second, *M. rimosipes*, furfuraceous. If they are distinct, our plant belongs to the latter, though the first has usually been recognized as the American plant. Vittadini [1] could not separate these forms, nor am I able to do so. The character of the stipe is too inconstant to be of value, at least in herbarium specimens, for watery plants, grown in wet weather, often have their translucent stems apparently nearly or quite smooth when pressed. Both forms are represented in English specimens distributed by Broome [2] as *M. semilibera*. *M. patula* P., if distinct, seems to be characterized chiefly by the greater prominence of transverse ridges, making the depressions of the pileus more regularly polygonal. *M. bispora* Sow., with a free pendent pileus, which is found in New York,[3] may be distinguished, if it also occurs in Wisconsin, by having 2-spored asci.

M. esculenta is esteemed for the table by most persons, and has usually been held to be entirely free from the noxious properties resident in many fungi. Under some conditions, however, the plants may develop poisonous principles; and when eaten raw, or even if the water has not been changed while cooking them, they occasionally give rise to indigestion or symptoms of poisoning. This is especially true of specimens gathered in wet weather, and of those which are past their prime or have been kept too long before cooking, for like all fleshy fungi they are readily putrescible. But where proper care is taken in selecting and cooking the specimens, the morel forms an excellent relish and is one of the safest of edible fungi. What has been said of this species applies generally to the genus *Morchella*, but I have eaten none of the other species.[4]

The only fungi that are likely to be confounded with morels are certain related genera, *Helvella* [5] and *Gyromitra*,—which produce asco-spores on the exterior of the folded but not reticulately ribbed or pitted pileus:—and the stink-horn fungi,—species of the basidiomycetous genus *Phallus*.[6] Most of the former are edible. No person possessing the sense of smell is likely

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[1] *l. c.* 114.

[2] Rabenherst's Fungi Europaei, No. 1417.

[3] Peck; 30 Rep. N. Y. Museum, 58.

[4] For an abstract of recent papers on the necessity for caution in preparing morels, see Bot. Centralblatt, xx. 243, and a paper by Böhm and Külz, in Archiv. für experiment. Pathologie und Pharmakologie, xix. Heft. 6 (Abst. in Bot. Zeitung, 1886, 643-4).—Useful recipes for the preparation of these fungi will be found in Röll: Die 24 häufigsten essbaren Pilze. Tübingen, 41-5.

[5] *Helvella crispa* (sometimes said to be poisonous) occurs in open woods about Madison, in late summer and fall.

[6] *P. duplicatus* Bosc. is common about Madison in summer and autumn, in lawns, grass by the roadside, etc.; and *P. caninus* has been collected at La Crosse by Mr. L. H. Pammel.

to entertain the thought for a moment of collecting the latter except under protest, and never of eating them, at least when mature.

II. PUFF-BALLS.

Order BASIDIOMYCETES. Sub-Order GASTEROMYCETES.

Fungi belonging to the Family *Lycoperdaceae* are usually, spoken of as puff-balls, from the powdery character of their spores, that in most species are emitted in clouds on the slightest touch. When young the plants are rounded, colorless and fleshy, and most of the species are then edible. Immature phalloids, already referred to, may be mistaken for puff-balls, but when cut across they show a layer of translucent jelly just under the surface. When ripe, the pretty little *Lycogala epidendrum*, which is comm on about Madison ondecaying wood, and the subterranean *Elaphomyces granulatus*, that we have not yet found, resemble, respectively, *Lycoperdon* and *Scleroderma* in their general appearance, but differ greatly in their development and fructification, the former belonging to the Myxomycetes, the latter to the Ascomycetes.

Our species of puff-balls may be referred to their genera by the appended key, which, it should be observed, refers only to Madison species and makes no provision for those which occur elsewhere:

Outer peridium forming a star when mature ..... *Geaster.*
Outer peridium not star-shaped.
  Spores mixed with a conspicuous thread-like capillitium. [1]
    Entire plant filled with spores and threads, the latter dichotomous from a main trunk ..... *Bovista.*
    Base usually more or less spongy and sterile: threads without a main stem ..... *Lycoperdon.*
  Spores when ripe without a fleecy capillitium.
    Plant with a solid central columella: spores brownish ..... *Secotium.*
    Without a columella; spores purplish ..... *Scleroderma.*

SYNOPSIS OF GEASTER.

Inner peridium sessile.
  Mouth few-toothed, not prominent, nor on a disk ..... *G. hygrometricus.*
  Mouth silky-striate, conical, on a round disk ..... *G. saccatus.*
Inner peridium stalked.
  Mouth protruding, deeply plicate, plant small ..... *G. Rabenhorstii.*
  Mouth not prominent or plicate, plant rather large ..... *G. limbatus.*

1. GEASTER HYGROMETRICUS. P.— Outer peridium leathery, usually irregularly 8-to-10-rayed, the lobes often notched or forked at apex; with a thick waxy inner layer cracking when dry, opening and closing with changes in moisture when fresh. Inner peridium sessile, depressed, rough-scurfy, with a star-shaped or irregularly torn, scarcely protruding mouth. Capillitium somewhat anastomosing. Spores rough, 10 to 12 μ. in diameter.— Pl. 1, f. 1.— Sandy places, in summer and autumn.

[1] For a comparative study of the capillitium of these and other genera see Hesse: Jahrb. f. wiss. Bot. x. (4), 383, pl. 28-29; Abst. in Bot. Jahresbericht, iv. 163.

A poor specimen was once picked up on the shore of Fourth Lake. The species is also reported from Wisconsin by Bundy, and has been collected at La Crosse (*Pammel*), River Falls (*King*), and Sparta (*Miss Rose Schuster*): it ranges over the entire country, from the Atlantic to the Pacific, and is abundant in Europe.

Figures:—Morgan, American Naturalist, xviii, 969, f. 12; Trelease, St. Nicholas, xiii. 875, f. 2. *Exsiccatae:*—Ravenel, Fungi Carol., iii, No. 75; Fungi Amer. No. 471; Von Thuemen, Mycotheca Universalis, No. 110; Ellis, N. A. Fungi, No. 108.

2. Geaster saccatus Fr.—Outer peridium usually eight to ten lobed, the sinuses extending halfway to the base, the lobes reflexed; varying from cream-color to dark brown, the darker specimens occasionally white-striped on the outside from the cracking of the outermost layer. Inner peridium usually a little paler, sub-globose. Mouth prominent, conical, on a distinctly marked disk, silkystriate, sometimes darker than the rest of the peridium. Spores brown, semi-opaque, coarsely warted, 3.7 to 5 μ. Pl. 1, f. 2. Abundant in damp woods. August and September.

This species, extremely variable in size and color, has been variously referred by writers. The type (represented in the Lapham herbarium, from the Penokee Iron Range) is larger and coarser than our form, which corresponds nearly to *G. vittatus*, Kalchbr., but the white striping of the outer peridium is exceptional, for specimens growing together differ in this respect, though evidently belonging to a single species. In size and general appearance our plant resembles *G. fimbriatus* Fr., the mouth of which, as indicated in descriptions and shown by European exsiccatae, is less prominent and not on a sharply limited disk.

Figures:—Morgan, *l. c.* 968, f. 9. *Exsiccatae:*—Ravenel, Fungi Carol., i, no. 77.

3. Geaster Rabenhorstii Kunze.—Small. Outer peridium at length papery, whitish buff, mottled with dark brown; divided into six to eight strongly reflexed lobes. Inner peridium lead-color or brown, distinctly stalked with a prominent apophysis at summit of stipe. Mouth conical or cylindrical, deeply furrowed longitudinally. Spores dark brown and opaque, irregularly globose, coarsely papillate, 4.5 to 5 μ.—Pl. 1, f. 3.—Sandy woods.

Found once in small numbers under a clump of larches on the University grounds. I have seen the same plant in the collection of Professor Peck, at Albany. It has doubtless often passed for a small form of *G. striatus* (DC.), and is referred to that species by Peck (38 Rep. N. Y. Museum, 94). It is *G. Schmideli* Vitt. of Winter's Kryptogamen Flora, and may really be the plant figured by Vittadini.

4. Geaster limbatus Fr.—Large. Outer peridium seven or eight lobed, the segments strongly reflexed but with incurved tips. Inner peridium brownish or gray, globose or somewhat depressed, raised on a short compressed slightly apophysate stipe. Mouth fimbriate, on a more or less evi-

dent disk. Spores less opaque and more finely granulated than in the last, 4 μ.— Pl. 1, f. 4.— Open woods. Wisconsin specimens collected by Bundy, also occur in the herbarium of Professor Peck.

Figures:— Morgan, *l. c.* 967, f. 6. *Exsiccatae:*— Ellis, N. A. Fungi, no. 1309.

Geaster bryantii, B., reported by Bundy in Rep. Geol. Surv. i, 399, presumably on specimens of *G. limbatus*, is similar, but with an elongated mouth plicate as in *G. Rabenhorstii*, and with a delicate cup at base of the stipe which, in typical specimens, is also surrounded by a hanging collar-like fold below the apophysis.

Geaster striatus (DC.), also recorded by Bundy, perhaps a specimen of *G. saccatus*, resembles that species in its general features, but the inner peridium is more or less stalked and the mouth plicate, while the outer peridium is not saccate at base.

Geaster triplex Jungh., which is represented in the Lapham herbarium by a specimen without date or locality, is recognized by a lacerated cup-like intermediate layer, which surrounds the base of the inner peridium. It should be observed that a similar but inconstant and much smaller middle peridium is occasionally seen in the *vittatus* form of *G. saccatus* as it occurs about St. Louis, and is figured in *G. hygrometricus* by Corda (Icones Fungorum, vi, pl. 4, f. 42, nos. 16–17).

Synopsis of Bovista.

Less than 1 in. in diameter; spores obovoid, long-pedicelled — *B. plumbea.*
Over 1 in. in diameter; spores globose, short-pedicelled — *B. pila.*

1. Bovista plumbea P.— Usually half an inch to an inch in diameter, irregularly globose or depressed when old. Peridium at first double, the outer layer dull white, flaking away, the inner white to lead-color or sometimes dark purplish gray or even nearly black when old, smooth and slightly glossy, dehiscent at the apex by a round or oblong fissure mostly with revolute margins. Capillitium deep chestnut brown, much branched, the twigs blunt. Spores brown, nearly smooth,[1] short obovoid, 5—6×6—7 μ, with colorless pedicels 2×17 μ.— Pl. 1, f. 5.— Very common in open hilly pastures; also sent from River Falls (*King*), and doubtless occurring everywhere.

B. plumbea and *B. nigrescens* are species readily confused if they are really distinct. I have as yet failed to convince myself that our larger, darker plants are more than a form of *B. plumbea*. Fries (systema, iii. 24) records both as American; but I have seen no specimens corresponding closely to *B. nigrescens* as figured in Berkley's Outlines of Brit. Fungology, pl. 20, f. 5. Sturms Flora Heft 18, pl. 15; Bolton's Funguses about Halifax, pl. 118; and Sowerby pl. 331. Our common form is well represented by Micheli, pl. 97, f. 6; Corda, Icones, v, pl. 6, f. 47, nos. 3–4 (the former inverted); Vittadini, Funghi Mangerecci, pl. 33, f. 1; Berkeley, *l. c.* pl. 20, f. 6; and Sturm's Flora. Heft 18, pl. 16 (copied by Winter). It is hard to see on what grounds Fries and Winter refer Batsch. pl. 29, f. 166 to *B. nigrescens.*

[1]The descriptions in this paper apply to spores that have not been much soaked in water, since the markings of many more or less completed disappear when the spores are wet, as the case of some Ustilagineæ and Uredineæ.

A small lead-colored specimen from Albany, N. Y., in the Curtis herbarium (*Peck*, no. 76), under this name has round nearly stalkless rough spores 5 μ in diameter, and is evidently a denuded plant of *B. circumscissa* B. &. C., not yet found in Wisconsin.

I can corroborate the assertion of Vittadini that this is one of the most delicate of edible fungi when gathered young and properly cooked. The first sign of discoloration, as with other puff-balls, marks it as too old for the table.

2. Bovista pila B. & C., seldom less than an inch and a half in diameter, usually two or two and a half inches, irregularly globose or somewhat pinched in at the base, which often bears remnants of a myceliæ cord. Peridium with at most a very delicate flaking outer layer, typically smooth and glistening, grayish-buff, dark gray or blackish-purple, usually dehiscing late by an irregular fissure at no fixed point. Twigs of the capillitium wavy, tapering, chestnut-brown, paler toward the tips, fading to a decided pink in old weathered specimens. Spores nearly spherical, stalkless, 3, 5—5 μ, nearly smooth, paler than in the last.—Pl. 1, f. 6.—Abundant in wood-pastures, less frequent in open fields.

This species was originally described (Grevillea, ii. 49) from Wisconsin specimens collected by Lapham. I have seen other specimens from Sheboygan (*Brown*), Sparta and Middleton (*Miss Schuster*), Bloomingdale and La Crosse (*Pammel*), and have collected it in abundance at Weyauwega. In its nearly single peridium and irregular dehiscence, this is decidedly unlike typical species of *Bovista*. Like the last, it is excellent eating when gathered young and properly cooked.

Bovista ammophila, Lév., reported (perhaps on specimens of the last) from Wisconsin by Bundy (Rep. Geol. Surv., i, 399), has a similar cord-like base, but is distinguished by its spores, which, as figured by Lévéillé (Ann. Sci. Nat. Bot. 3 ser. ix, pl. 9, f. 5–6), are prominently obovoid and long-pedicelled.

B. subterranea, Pk., a depressed-globose species, which matures just below the surface of the ground, bulging it up at maturity; is recognized by its firm dull-brown inner peridium, half an inch to an inch and a half in diameter, opening by a small apical pore; its fleecy outer peridium, impregnated with dirt and evanescent above; and olive-purple capillitium and spores, the former flexuous and rather sparingly branched, the latter globose, stalkless, rough, 4—7 μ in diameter. This species, described from Dakota specimens, has been collected by me in Colorado, and comes from River Falls (*King*), so that it may be looked for at Madison, in sandy soil.

Mycenastrum spinulosum, Pk. (Bot. Gaz., iii, 170; vi, 240) a species of the Southwest which also occurs in the collection made by Dr. Brown at Sheboygan; is a gray puff-ball, irregular or kidney-shaped, measuring as much as four inches in its greatest diameter. It may be recognized by its smooth, almost woody, peridium, nearly one-sixteenth inch thick, at last breaking stellately, often with serrate edges to the lobes, and by its purple-

brown spinose capillitium and rough, opaque, paler spores 10 to 12 μ in diameter. It differs from the European *M. Corium* Desv. (also found in Arizona and Colorado) in its decided purple color when freshly broken. I have been able to test this latter species in Colorado, and find it palatable.

SYNOPSIS OF LYCOPERDON.[1]

Plants large; peridium flaking away irregularly at top.
- Sculptured and somewhat furfuraceous when young ..... *L. favosum.*
- Not sculptured, mostly glabrous: very large ..... *L. Bovista.*

Small or medium-sized; opening by a pore at apex.
- Spores brown, yellowish, or olive, smooth or minutely roughened.
  - Shaggy or with deciduous spines.
    - Spores long-pedicelled ..... *L. pedicellatum.*
    - Spores stalkless.
      - Fleecy, sessile; old peridium not pale-areolate; growing in meadows and grass land ..... *L. Wrightii.*
      - Warty, the larger spines deciduous, leaving pale round dots; growing in the woods ..... *L. gemmatum.*
  - Smooth, or at most scurfy, (rarely sub-shaggy, in *L. pyriforme?*).
    - On rotting wood; gregarious; mostly stalked, with creeping white fibers ..... *L. pyriforme.*
    - On the ground; not gregarious.
      - Spores ellipsoidal ..... *L. oblongisporum.*
      - Spores round or slightly obovoid.
        - Peridium not dark-dotted, often mealy-scurfy.
          - Sessile; usually under three-fourths inch ..... *L. pusillum.*
          - Often stalked; larger ..... *L. molle.*
        - Peridium dark-dotted when mature; sessile ..... *L. coloratum.*
- Spores more or less red-purple, rough-warty.
  - At first spinulose or shaggy.
    - Spines very long, white, all deciduous ..... *L. pulcherrimum.*
    - Spines shorter, buff or brown.
      - Mature peridium mealy-roughened, but glossy ..... *L. atropurpureum.*
      - Not mealy; reticulated with small brown warts ..... *L. constellatum.*
  - Not at all shaggy.
    - Reticulately furrowed; somewhat flesh-colored ..... *L. rimulatum.*
    - Not furrowed; buff ..... *L. glabellum.*

1. LYCOPERDON FAVOSUM (Rostk.).— Three to six inches in diameter, four to five inches high, depressed. spherical with a stout conical base, marked with coarse angular depressions, the pale fleecy outer peridium cracking so as to expose the brown inner layer, in anastomosing lines. Spores and capillitium, snuff-color or greenish-brown, liberated by the breaking away of the thick but fragile peridium. Spores slightly obovoid, nearly smooth, stalkless, 4.25 — 4.5 × 4.5 — 5 μ.— Pl. 1, f. 9.— Grassy fields, late summer and autumn.

[1] Since the preparation of this paper, which was presented to the Academy in 1884, two important publications on Lycoperdaceæ have appeared, namely: a revision of the genus *Lycoperdon* by Massee (Trans. Roy. Microsc. Soc. 1887, 701), and the compilation of the entire group by De Toni, for the seventh volume of Saccardo's Sylloge Fungorum. So far as possible, these have been consulted in a final revision of the manuscript for publication. —May 10, 1888.

I have had some doubt as to whether this plant, collected but once, should be referred to *L. favosum* or *caelatum*. The latter species is reported by Bundy (Rep. Geol. Surv. Wis. i, 399) and Peck (U. S. species of Lycoperdon, 12), from Wisconsin, and I have seen unmistakable specimens of it from this state in the herbarium of Professor Peck, while it appears to be pretty frequently met with in the west.

2. LYCOPERDON BOVISTA L. (L. giganteum of most authors).—Seldom under ten inches in diameter, often very much larger: smooth, or at least not floccose-sculptured nor pitted like the last. Peridium less corky, flaking away in thinner more papery layers, spores and capillitium yellower, the latter not separating from the sterile base. Spores nearly globose, almost smooth, 4 to 4.5 μ.—Grass land in late summer and autumn. Also reported from Wisconsin by Bundy (*l. c.*).

Figures: — Palmer, Mushrooms of America, pl. 8, f. 1.

Lycoperdon cyathiforme, Bosc., which occurs in the Curtis herbarium from Wisconsin (*Sprague*, 1169, Coll. *Lapham*), has been collected at Sheboygan (*Brown*), River Falls (*King*), and La Crosse (*Pammel*), and is also mentioned by Bundy (*l. c.*), is a stout pear-shaped or depressed-globose puff-ball approaching *L. callatum* in size, but easily distinguished by its smoother but areolated outer peridium, flaking away near the top as a thin papery layer, revealing the thicker fragile purple inner layer, and by its round finely granulated very purple spores, 4.5 to 6 μ in diameter. The sterile base persists for a long time, and is what Bosc's description (Mém.s. quelques espèces de champignons des parties mérid. de l' Amér. Sept., 5–6, pl. 6, f. 11) and figure were taken from. The American plant is not distinct from that which Vittadini[1] at first referred to *L. Bovista*, but afterward called *L. fragile*.

These three species are esteemed for food, whereas most of the smaller species of the genus have a disagreeable flavor. On this subject see Peck, U. S. Sp. of Lycoperdon, 7; 32 Rep. N. Y. Museum, 62; Country Gentleman, November 5, 1885; Palmer *l. c.;* and a note by myself in St. Nicholas, September, 1886; as well as Badham and other European writers on edible fungi.

3. LYCOPERDON PEDICELLATUM Pk.—Depressed globose to obovoid or sub-pyriform, usually one to two inches in diameter, with coarse angular or slender stellately united spines, a minutely granular darker recticulum between their bases. Denuded peridium, dull pinkish or buff, with round or polygonal depressions corresponding to the insertion of the fallen spines: base granular with more or less persistent coarse warts. Spores olive-yellow, slightly obovoid, minutely granular, 4-5 $\times$ 5–6 μ, with slender nearly colorless pedicels 18 to 25 μ long.—Pl. 1, f. 7.—Found once on the ground in open woods; received from River Falls (*King*); and locally abundant elsewhere, often in open places.

It has frequently been asserted that the spores of *Lycoperdon* are stalkless while those of *Bovista* are pedicelled. Understanding stalkless to mean (as in this paper) with a pedicel not exceeding 1 μ in length, this generaliza-

[1] Funghi Mangerecci, 263–8, pl. 33, f. 2. See, also, Berkeley, Notices of N. A. Fungi, no. 332.

tion is not true. *L. cepaeforme* and *L. Hongkongense*, like the present species, have their spores permanently stalked. The sterigmata of the group with red-purple spores (nos. ——) are at first very long, and they are also sometimes subpersistent. On the other hand the spores of a number of species referred to *Bovista*, *e. g. P. pila*, *B. circumscissa*, and *B. tosta*, are not pedicellate.

4. LYCOPERDON WRIGHTII B & C.— Round or broadly pear-shaped, often gregarious and more or less angular from mutual pressure; three-eighths to three fourths inch in diameter; densely covered with short grouped white spines that are buff and deciduous at maturity, exposing the pubescent or nearly smooth, dirty straw colored or buff inner peridium. Spores and capillitium pale greenish buff, the former finely granular, round, stalkless 3.5 to 4.25 μ. — pl. 1, f. 8.— Very abundant at the sides of paths and on open, bare places in dry, closely cropped grass land.

Specimens have also been sent me from River Falls (*King*), Sheboygan, (*Brown*), and Sparta (*Miss Schuster*), and the species is reported by Bundy in the list already referred to.

Lycoperdon cruciatum Rostk. (*L. separaus* Pk., *L. Wrightii*, var. *separaus* Pk.), of which doubtful immature specimens have been collected about Madison, and which Miss Schuster sends from Sparta, and Professor King, from River Falls, occurs more commonly in shaded places and is distinguished by its somewhat large size (half an inch to two inches) and more clay-colored or darker spores which are often pedicellate or intermingled with fallen sterigmata 5 to 7 μ long; and especially by the (very soft and flexible often dark brown) velvety inner peridium, from which the closely united white spines flake away in a continuous layer. The American plant corresponds well with the figure of Rostkovins (Sturm's Flora, Heft. 18. pl 8), though its spines are more crowded than in the figure. If the last runs into this, the name of Rostkovins must have precedence.

5. LYCOPORDEN GEMMATUM Batsch.— Usually gregarious, one to two inches in diameter, sometimes as much as three inches high, commonly top shaped, the fertile pair contracting into a stout obconic stem which equals or surpasses the enlarged summit in length, white, passing into pale buff or gray; with fleshy deciduous warts and intermingled more persistent smaller ones. Spores pale brown, thin-walled and translucent, finely granulated, round, stalkless, 3.5 to 4.5 μ.–Pl. 2, f. 1. Very abundant on the ground or occasionally on decayed wood, in the woods.

The Lapham herbarium contains specimens from Milwaukee, and I have seen others from Sheboygan (*Brown*). Bundy also reports the species. The most characteristic feature of this, which is one of our commonest species, is the occurrence of solid fleshy warts, often one-sixteenth of an inch or more in length, which stud the upper part of the peridium, giving it an appearance of great beauty when young. These are easily removed, leaving round, pale spots, one-thirty-second to one-sixteenth inch in diameter, on the peridium, elsewhere covered with fine granules. Even on old weathered specimens when the latter have entirely disappeared from the top, the characteristic pale spots are to be found toward the base.

Figures:— Palmer, Mushroons of America, pl. 8; Trelease, St. Nicholas, xiii, 875, f. 4. *Exsiccatae:*— Ellis, N. A. Fungi, no. 1,699.

6. LYCOPERDEN PYRIFORME Schaeff.—Our most variable species, globular, pear-shaped, or clavate, sesaile or stipitate, usually five-eighths inch to an inch in diameter, and half an inch to an inch and a half high (exceptionally as much as one and one-fourth by two inches). Peridium buff, covered with uniform persistent coarse dark brown granules (exceptionally with substellate short spines?). Spores pale olive, smooth, round, 3.5 to 4.5 μ stalkless.—Pl. 2, f. 5. Very common in woods, on old stumps, buried sticks, etc., the plants commonly gregarious, and connected by coarse white fibers.

I have also examined specimens collected at Sheboygan (*Brown*), and River Falls (*King*), and others occur in the Lapham herbarium. Bundy also mentions the species in his list of Wisconsin fungi.

Exsiccatae:— Ravenel, Fungi Carolin., ii. no. 72; Fungi Amer., no. 469.

7. LYCOPERDON OBLONGISPORUM B. & C.—Round to broad, pyriform, three-eighths in. to 1 in., usually narrowed below, with a mycelial cord at base. Peridium brown, at first furfuraceous, finally glassy, but with minute persistent granules. Spores greenish-brown, almost smooth, ellipsoidal, stalkless, 4×6 μ.—Pl. 2, f. 3.—Rather abundant on the bare ground in dense woods; August.

This pretty species, previously known only from Cuba,[1] is indistinguishable from the next when immature, the spores affording the only really characteristic feature. It has probably been overlooked in the past chiefly for this reason and because the mature plants, from their leaf-brown color, are not at all conspicuous. *L. Hongkongense* B. & C. (N. Pacific Expl. Exped. Fungi,—Proc. Amer. Acad. 1858,—124, no. 119), as I find from an examination of original specimens in the Gray herbarium at Cambridge, is a little more elongated than this species but with the same microscopic characters otherwise. Its spores, however, differ in being long-pedicelled. In their memoir on *Lycoperdon* and *Scleroderma* (Ann. Sci. Nat. 1842, Ser. 2, xvii, 13–14, Pl. 2, B. f. 5–7) the Tulasnes figure pedicellate oblong spores for some plants of *L. cepaeforme* Bull., which is referred to as synonymous with *L. pusillum* Fr. and *L. ericetorum* P.

8. LYCOPERDON, PUSILLUM Fr.—Microscopic characters of the preceding, but usually paler and less glistening when mature. Spores round or barely obovoid, nearly stalkless, 3.5 to 4.5 μ, evanescently minutely roughened or smooth.—Pl. 2, f. 4.—Rather frequently on the ground, in open fields; also sent from River Falls (*King*), and reported by Bundy (*l. c.*)

Exsiccatae: Ravenel, Fungi Carol. ii, no. 73; Fungi Amer. no. 138.

9. LYCOPERDON MOLLE P.—Depressed, globose, half an inch to an inch and a quarter in diameter, sessile or on a stipe of equal length. Peridium cream-color passing into buff, mealy-furfuraceous, glistening when old. Spores olive, round, stalkless, minutely echinulate, 3.5 to 5 μ.—Pl. 2, f. 6.

On the ground in open woods and pastures; also collected at River Falls (*King*).

[1] Berkeley & Curtis, Fungi Cubenses (Journ. Linn., Dec., 1867), 345, no. 505.

This species superficially resembles small plants of *L. glabellum* Pk. so closely that it is difficult to distinguish them. When cut open, especially if gathered immature and allowed to ripen in the laboratory, it sometimes also presents a red-purple section; but this does not depend upon the color of the spores, which afford constant and certain means of distinguishing the two species, since in this they are about as in *L. gemmatum*, while in *L. glabellum* they are nearly as in *L. constellatum* or the related species of the purple-spored section.

10. LYCOPERDON COLORATUM Pk.— Round, and somewhat depressed and contracted at the base, three-eighths to one inch; from pure white passing into yellowish and at maturity buff; granular-mealy; finally glistening and dotted with minute dark granules that persist or often rub away from large areas. Spores and capillitium buff, the former paler, round, smooth, stalkless, 4 to 5 μ.— Pl. 2, f. 2.— On the ground in damp woods; August.

11. LYCOPERDON PULCHERRIMUM B. & C. (*L. Frostii* Pk.)— Obovoid, an inch to an inch and a half in diameter and about as high. Peridium coffee-color at maturity, covered with very deciduous slender white spines, often three-sixteenths inch long, clustered by their tips; usually smooth and glossy after their fall. Capillitium at last red-purple, spores varying from pale buff to reddish-purple, round, with very low colorless warts, nearly stalkless, 4 to 6.5 μ.— Pl. 3, f. 1.— Open grass land, not uncommon.

In this and other species of the purple-spored Proteoids the pedicels of the spores, even in mature specimens, are sometimes 2 to 4 μ long, whereas in other groups the species that have not long pedicelled spores very rarely show pedicels much over 1 μ long.

The spores of the group of species which follows are very uniform, coarsely warted and usually short-stalked. As shown by Peck (U. S. species of Lycoperdon, 18), they are intermingled with fragmentary colorless rods, to which they are not attached, but that represent the fallen remnants of long sterigmata, as may be seen by examining young specimens. In this paper (p. 22) and in 32 Rep. N. Y. Museum, p. 68, Peck states that *L. pulcherrimun* B. & C. is evidently the same as *L. pedicellatum* Pk., an opinion which I shared until, in looking through the puff-balls of the Curtis herbarium, which Dr. Farlow obligingly placed in my hands, I found the type of *L. pulcherrimum*, gathered in Pennsylvania, in 1852, and preserved under the number 3933. The description by Berkeley (Notices of N. A. Fungi, 50, No. 336,— Grevillea, ii, 51) is certainly more applicable to *L. pedicellatum* than to this species, especially as regards the size and color of the spores; but unless two entirely different things were collected under this number, so that Berkeley's description was not drawn up from a duplicate of the Curtis type, there can be little doubt that *L. Frostii* and not *L. pedicellatum* is a synonym of *L. pulcherrimum.*

12. LYCOPERDON ATROPURPUREUM Vitt.— Extremely variable in size and form, three-fourths to two and one-half inches in diameter, one and one-fourth to three inches high, obconical or pyriform to subglobose; nearly

sessile or on a long stipe. Peridium straw color or dull buff, nearly spineless or with sharp, dark spines, often united in clusters by their tips, furfuraceous with a more or less evanescent mealy coating through which the inner layer appears glossy. Spores purple-brown, coarsely granular, round, 4.5 to 6.5 μ, nearly stalkless or with pedicels 2 to 4 μ long.— Pl. 3, f. 2.— Rather frequent on the ground in bushy woods, or occasionally on decaying wood. Reported by Bundy, and occurs from Wisconsin (*Lapham*) in Hb. Curtis as *L. saccatum*. The more spinose form is var. *hirtellum* Pk.

Though easily recognized in most of its forms, this is one of the most perplexing of our species. Berkeley and Curtis as well as Dr. Winter, who examined some of our specimens, have considered the plant to be *L. saccatum* Fr. As *saccatum* is understood by Bouerden (Bot. Zeitung, 1857, 596), and Winter (Rabenhorst's Kryptogamen-Flora, i, 901), this determination is unimpeachable; but *L. saccatum* of Fries and the Flora Danica (Pl. 1139), has a flaking peridium similar to that of *L. bovista* and *L. cyathiforme*, whereas our plant possesses a persistent peridium opening by a terminal pore. Recognizing this, Winter (*l. c.*) admits that Bouerden appears not to have possessed the true species of Fries, yet does not hesitate to follow him. The real *saccatum*, which occurs in New York, is certainly very distinct.

Figures:— Palmer, Mushroons of America, pl. 8, as *L. saccatum*. *Exsiccatae:*—Ravenel, Fungi Carolin., iv, no. 73, in part, as *L. gemmatum*.

13. Lycoperdon constellatum Fr. Subglobose or more commonly in the form of an oblate spheroid, somewhat pinched-in at base, one to two inches in diameter. Peridium straw-color, gray or copper, at first with deciduous brown spines clustered by their apices, and intervening low brown warts that persist as a prominent reticulum, or, ultimately falling, leave the peridium minutely facetted, somewhat resembling "hammered work" in metal. Spores nearly as in the last, 5 to 6.5 μ. Old capillitium brown.— Pl. 3, f. 4.— On the ground in bushy woods.

Though more depressed than *L. umbrinum* of the Flora Danica (pl. 1800), which is the prototype of *L. constellatum*, our plant agrees so well with the descriptions, that I have followed Peck in referring it to that species. According to Dr. Winter, it nearly resembles *L. cupricum* Bouerd.

14. Lycoperdon rimulatum Pk. in herb.— Depressed globose, pinched-in and radicating at base, slightly umbonate at apex, three-fourths to one and one-half in. in diameter. Peridium tawny flesh-color, thin, glabrous, rimulate with anastomosing furrows. Spores red-purple, rough-warty, 5 to 6.5 μ; their pedicels 2 μ or in immature specimens, as much as 15 μ long.— Pl. 3, f. 3.— On the ground in open wood pastures; September; also collected at River Falls (*King*).

An interesting plant, related to the *constellatum* group in its spore characters, but differing from our other species of this group in the absence of a spinose or mealy coating, the outer peridium merely cracking along the grooves as in *L. caelatum*. I am indebted to Mr. Peck for the name employed, which he has applied to immature specimens in his herbarium, from Ohio (*Morgan*) and New York.

15. LYCOPERDON GLABELLUM Pk.— Depressed globose, or elongated and stipitate, more or less umbonate, three-fourths to two in. high. Peridium buff, very finely furfuraceous. Spores and capillitium purple or more or less brown, the former 5 to 6 μ, with coarse warts, and short-pedicelled.— Pl. 3, f. 5.— On the ground in woods, accompanying *L. gemmatum;* River Falls (*King*).

Tulostoma fimbriatum Fr., a small puff-ball raised on a solid cylindrical stipe about one-eighth in. in diameter and as much as an inch long, may be recognized by its subglobose more or less granulated peridium, opening by a small scarcely protruding fimbriate mouth, brick-colored, remotely spinose, round spores 4-5 μ in diameter, and pale blunt anastomosing capillitium. I have received it in quantity from Professor King, of River Falls.

SECOTIUM.

1. SECOTIUM ACUMINATUM (Mont.) (*S. Thunii* Schulzer. *S. Warnei* Pk.)— Short stipitate, subglobose to conical ovoid, rounded or frequently more or less acuminate above.

Peridium rather leathery, dull yellowish-white, passing into buff; smooth or mostly with crenated scale-like elevations often free at their lower edge, dehiscing irregularly about the stipe, which is prolonged through the sporiferous portion as a stout columella one-fourth to one-half in. in diameter, and firmly united with the peridium at apex. Spore-bearing mass snuff-brown, extending laterally from the columella in a series of eroded friable thin gills. Spores yellow-brown, smooth, stalkless; extremely variable, spherical, ellipsoidal, or more or less regularly ovoid, 4-9×6-14, most commonly 6×8 μ.— Pl. 2, f. 7.— Abundant in late summer and fall in open pastures, etc. My largest specimens were obtained on the bare ground in a potato patch.

Reported from Wisconsin by Bundy (*l. c.* 399, — the specimens preserved in hb. Peck), and Peck (Bull. Torrey Club), and included in the collections of Dr. Brown, of Sheboygan, and F. H. King, of River Falls. Edible when young.

According to Schulzer von Muggenburg (Hednigia, 1883, 43), this species, described by Peck. as *Lycoperdon Warnei* (Bull. Torrey Bot. Club, vi, 77), *Podaxon Warnei* (U. S. Sp. Lycoperdon, 34), and *Secotium Warnei* (Bull. Torrey Cl. ix, 2), is identical with the European *S. Threnii* Schulzer, which is referrible to *S. Acuneinatum* (Mont.) Tul. *S. Szabolcsense* Hasl., judging from his figure and the abstract of his paper in Jost's Bot. Jahresbericht for 1876, p. 161, must be extremely closely related.

Figures:— Peck. Bull. Torry Bot. Club, ix. pl. 9, f. 6-11; Revue Mycologique, iv. pl. 16. f. 13.

Synopsis of Scleroderma.

Peridium thin, dark-dotted — — — S. verrucosum. More conaceous, uniformly colored, usually furrowed or sculptured.— . *S. vulgare.*

1. Scleroderma verrucosum (Vaill.) — Flattened biscuit-shaped, ¼ to 1¼ in. in diameter, nearly sessile or with a short stipe, radicating at base. Peridium thin and flexible above, but tough; yellowish buff, a thin outer layer cracking during development and persisting as small angular darker scales; dehiscence irregular, apical, spores purple, roundish, stalkless, sharply echinulate, 8 to 10 μ.— Pl. 3, f. 7.— One of the earliest and commonest of our puff-balls, on the bare ground in roads. I have also collected specimens above Kilbourn City, and the species is found at River Falls (*King*) and is named in Bundy's list.

Neither this nor the following species is considered fit for food,[1] though greedly devoured by snails. Even the young plants emit a disagreeable pungent odor, quite different from that of other puff-balls.

This is, at least in part, *S. Bovista* of Ellis, N. A. Fungi, no. 24; and, perhaps, of Von Thuemen. Mycotheca Universalis, no. 607,— both from New Jersey, but in my own copy of the Mycotheca, and in Dr. Farlow's, the latter number appears to be a form of *S. vulgare.* Our plant is that figured by Nees (Syst. du Schwämme, pl. 11, f. 124) under the name *Bovista plumbea*, obviously an error. It is not evidently different, except in the shortness of its stipe, from *Lycoperdon verrucosum*, *sphaericum*, etc., of Vaillant (Bor. Parisiense, pl. 16, f. 7), *L. verrucosum* of Bulliard (Pl. Vénén. de la France, pl. 24), *L. defossum.* Sowerby (British Fungi, pl. 311), and *Scleroderma verrucosum*, Greville (Scot. Crypt. Flora —, pl. —). It is also quite similar to that figured by Sorokine (Ann. Sci. Nat. 6 ser. iii. pl. 6 f. 12 f.) as *S. verrucosum*, and agrees in all essentials with a French specimen in the Curtis herbarium referred to *verrucosum* by Desmazieres. The transparent border to the young spores, figured by the Tulasnes (Ann. Sci. Nat. 2 ser. xvii. pl. 1, A. f. 8) in what they doubtfully refer to this species, and which I have noticed in *S. vulgare*, f. *minor* of Saccaede's Mycotheca Veneta. no. 1412, has not been observed by me in American specimens of either species; but is held by Caspary (Sitzber. Geo. zu Konigsberg, 1886, xxvii, 203) to be merely an immature character.

2. Scleroderma vulgare Fr.— Depressed globose, narrowed and radicating below, three-fourths to two in. in diameter. Peridium pinkish or buff, thick, smooth or finely checked by intersecting dark furrows about one-sixteenth in. apart. Spores as in the last, nine to fifteen μ, the spore-mass when maturing separated into small grains by bundles of pale gray hyphæ.

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[1] *Scleroderma vulgare* is commonly held to be poisonous to man, but according to Smith (Gard. Chron. 1885, 48) and Caspany (Schrift. Physik.— Ockonom. Gesellsch zu Königsberg, xxvii, 109; Bot. Centralblatt, xxx, 34), it is collected in parts of England and Germany as a truffle and eaten after cooking, without known ill effects. But its bad name should be borne in mind by anyone desirous of experimenting with it.

—Pl. 3, f. 6.—Grass land or in mossy dry woods. Also sent me from Sparta (*Miss Schuster*) and River Falls (*King*), and reported by Bundy.

Our Western form, as I have seen it at Madison and about St. Louis, is often smooth except for the simulate areolation referred to, in this respect differing from a common Eastern and European form, which is also decidedly yellow, but it is undoubtedly a form of the same polymorphic species. The *S. verrucosum* of Bundy's list is presumably the rougher plant, which is shaggy with coarse scales, often free and recurved above.

Scleroderma Bovista Fr., named in Bundy's list, differs from *vulgare* in its thinner peridium, and from both of the preceding species in the more olive spore-mass with intermingled yellow flocci; otherwise it closely resembles *S. vulgare*, from which, like Caspary (*l. c.* 204), I often find it hard to separate it.

Elaphomyces, one of the Tuberaceae, developing underground, when mature resembles a *Scleroderma:* but its spores are borne in asci that are evident in young plants. We have as yet found no representative of this genus, which should be looked for in pine woods, etc.

EXPLANATION OF PLATES.

The plants are represented of the natural size, and their spores uniformly enlarged 2000 diameters.

PLATE VII.

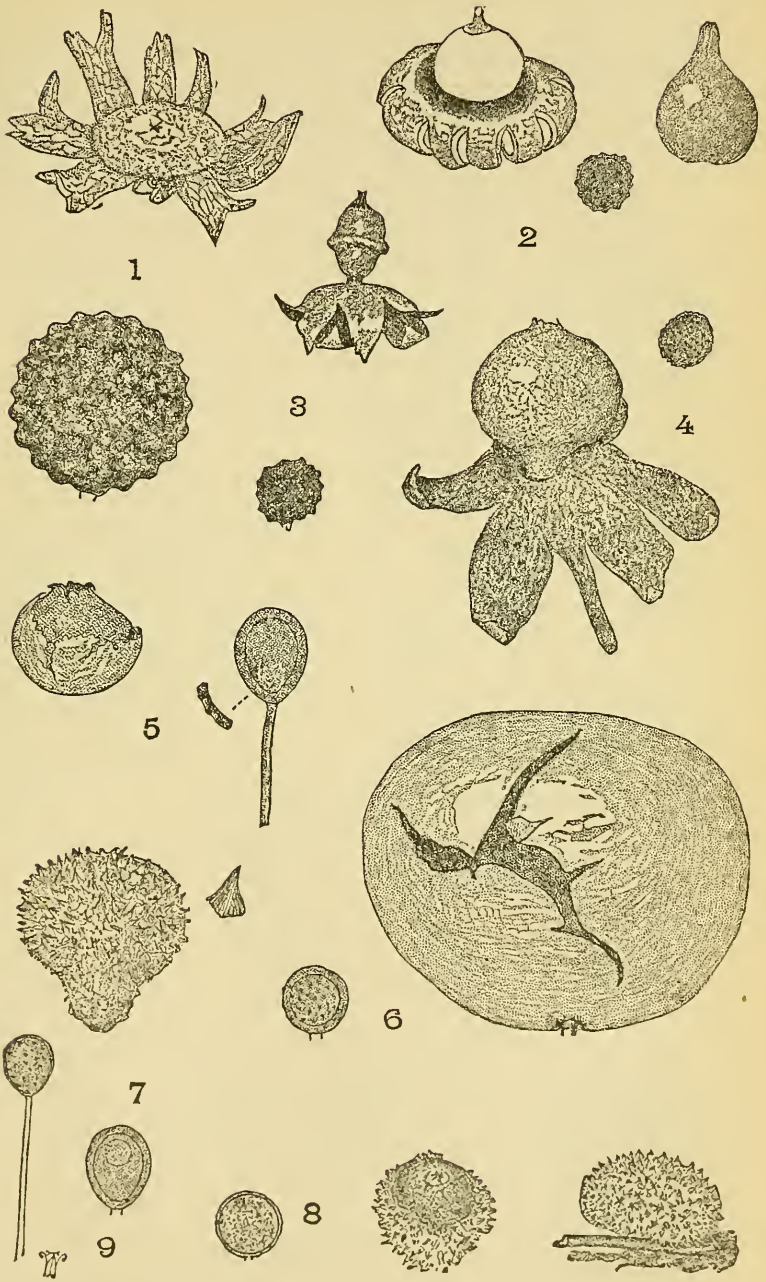
1, Geaster hygrometricus and spore; 2, G. saccatus and spore; 3, G. Rabenhorstii and spore; 4, G. limbatus and spore; 5, Bovista plumbea and spore; 6, B. pila and spore; 7, Lycoperdon pedicellatum (small specimen) and spore; 8, L. Wrightii, two plants and spore; 9, spore of L. caelatum.

PLATE VIII.

1, Lycoperdon gemmatum and spores; 2, L. coloratum and spore; 3, L. oblongisporum and spore; 4, L. ericetorum and spore; 5, L. pyriforme and spore; 6, L. molle and spore; 7, Secotium acuminatum, in section, and spore.

PLATE IX.

1, Lycoperdon pulcherrimum and spore; 2, L. atropurpureum, three plants and spore; 3, L. rimulatum and spore; 4, L. constellatum (?) and spore; 5, L. glabellum and spore; 6, Scleroderma vulgare and spore; 7, S. verrucosum,—subsessile and stipitate forms.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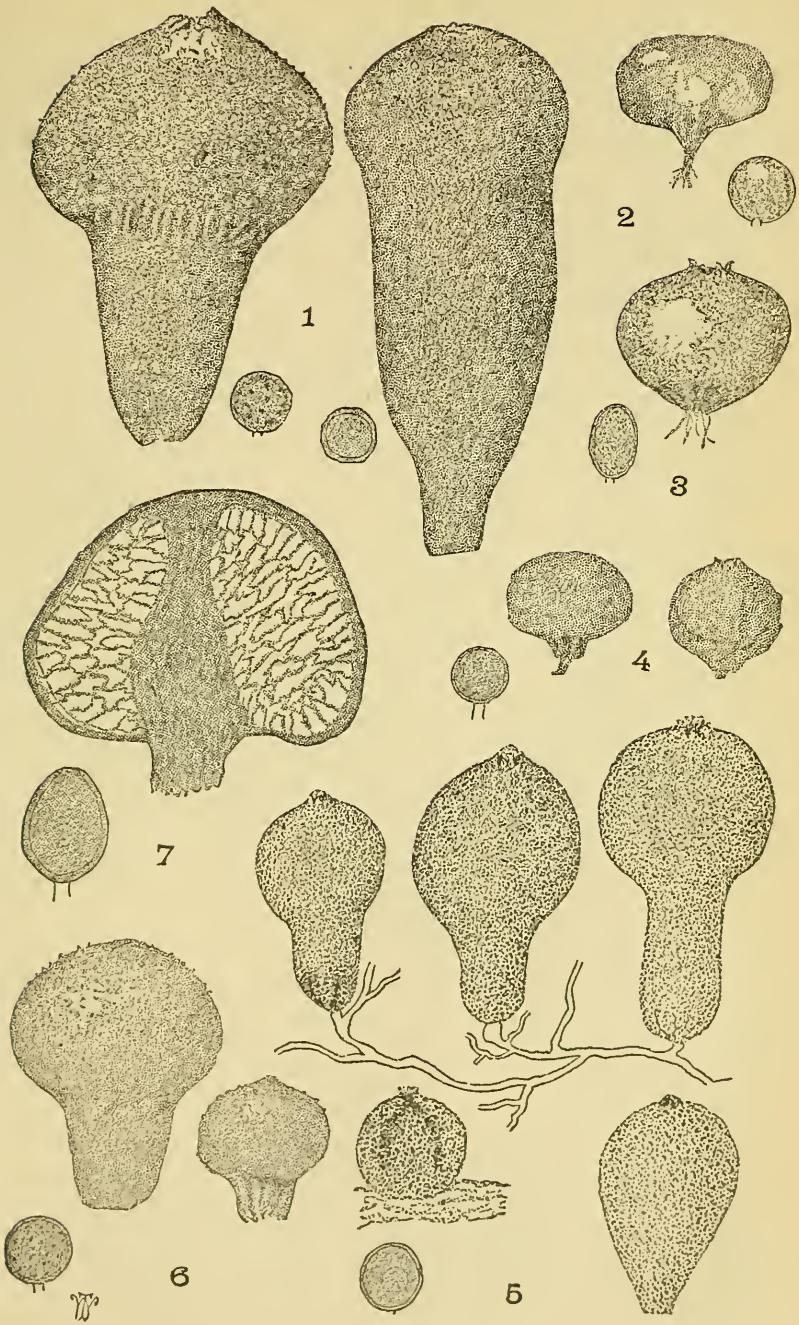
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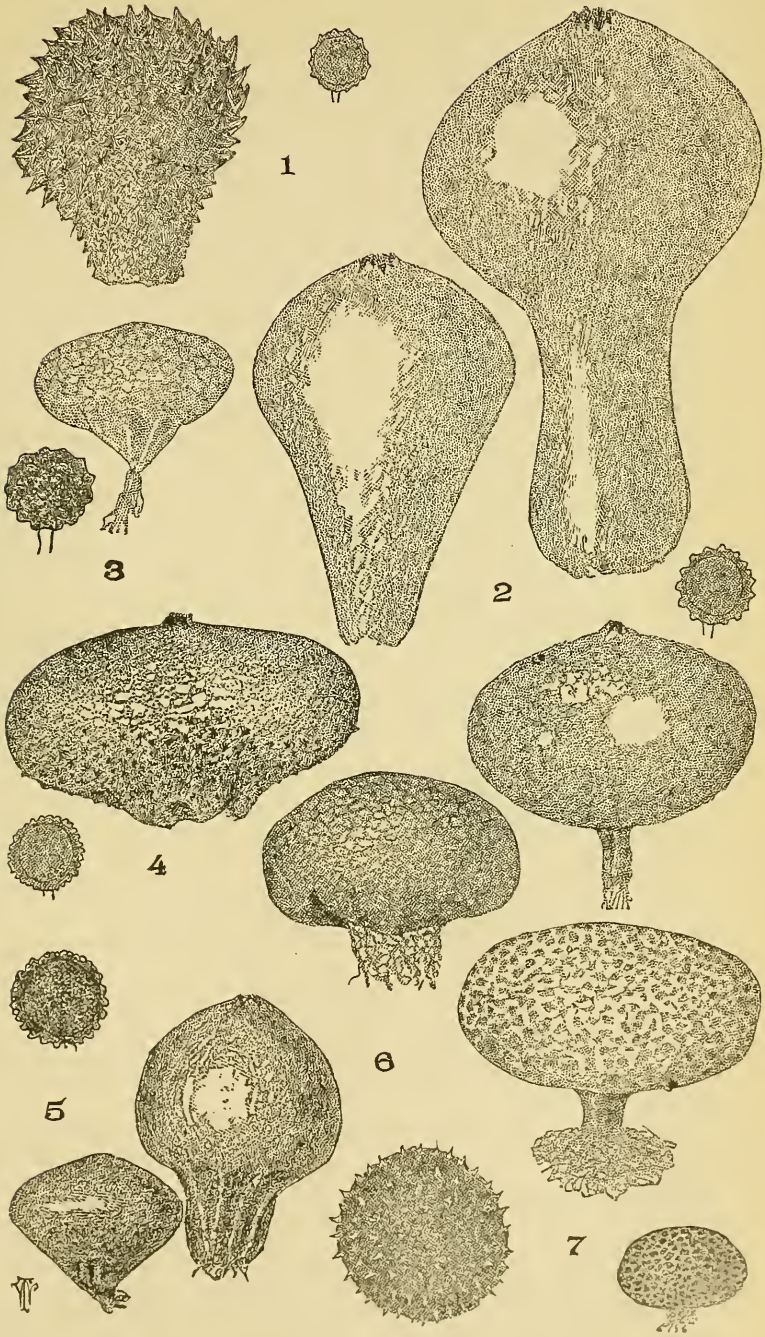
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THE "WORKING" OF THE MADISON LAKES.

By WILLIAM TRELEASE.

Every season a greenish-yellow scum occurs in greater or less quantity on Third and Fourth Lakes (Mendota and Monona), during the hot weather of summer, after the water has been calm for a number of days in succession. When but little of it is present, it appears as fine granules suspended in the water, often scarcely visible to the naked eye except as they reflect the light, when they call to mind the dancing motes in a beam of sunlight. Under the influence of a gentle, but continuous breeze, these particles are collected into fleecy masses, and driven ashore, so that they accumulate along the margin of the lake, forming a slimy scum which quickly putrefies, giving off a very disagreeable odor. During this change, its color changes to a decided blue-green, which stains the pebbles, sticks, etc., over which it is smeared. The appearance of this scum is sometimes spoken of as the working of the lakes, from a resemblance to the collection of a scum on cider, etc., when fermenting, or, as an American idiom expresses it, "working."

Usually the scum is seen in small quantity and only attracts attention for a day or two at a time, in midsummer, when it collects on the city side of the lake; for a change in the direction of the breeze, or a brisk wind from any quarter usually scatters it in a short time. In the summer of 1882, however, the working of the lakes was noticed early in June, and on the 17th of that month enough scum had collected along the city shore of Fourth Lake to prevent boating. The odor which it gave off was noticeable at a distance of one or two blocks from the water. After a few days a change in the wind brought relief for a time, but the trouble was renewed at frequent intervals until the middle of November. The first formation of this scum was apparently traceable to the long, shallow bay between Picnic and Second Points, in Fourth Lake, and to the bay at the west end of Third Lake, from which it was scattered by winds, and afterward increased everywhere.

In the summer, during calm weather, the water within a foot or two of the surface was everywhere filled with the minute granules already referred to. In places where counter currents met, as off Picnic Point, these were collected in a local surface film. While this appearance lasted the fish in the lake bit very little. On several occasions white bass were found in large schools

off the points, jumping under films of this nature, apparently at the glistening air-bubbles which were entangled at the surface; but though the entire range of the fly-book was tried, they persistently refused the hook. In other parts of the lake where there was little scum, the fish, especially pickerel, bit more freely.

The floating bodies, which at times are as large as pin heads, have once or twice been noticed as a cause of the dispersion of sunlight in a beautiful manner. One calm, bright morning in the fall, a student while rowing, observed a spectrum on the surface of the lake, which took the form of a parabola, with its vertex at his boat. To another person on shore, the spectrum appeared nearly straight. The appearance was of the same nature as the rainbow, and was apparently caused by refraction in the floating dots, which slightly projected from the smooth surface of the water, that covered them with a thin film. A breeze quickly ended it.

The working of the lakes at Madison corresponds to what is known in parts of Great Britain as the "breaking" of small bodies of water. On the continent, a similar scum is spoken of as water-bloom (Wasserblüthe, Fleur d' eau, Flos aquæ). In all these cases, the phenomenon depends upon the multiplication of minute algæ belonging to the group Cyanophyceæ, which usually accumulate suddenly and often disappear after a few days, either temporarily or for the balance of the season. Sometimes the bloom is said to disappear at nightfall, in quiet water, to re appear the next morning. The futility of fishing at such times is generally recognized in Europe, the common impression being that the fish are then sick. In this connection it may be said, however, that the wholesale death of fish, especially perch, in Fourth Lake, during the summer of 1884, and the death of numbers of whitefish every summer has apparently no connection with the water bloom.

Thuret divided the Cyanophyceae into Chroococcaceae and Nostochineae; the former with their cells not in chains; the latter with their cells placed end to end, forming filaments. The Nostochineae have since been separated into several groups equivalent to the Chroococcaceae, but for our purpose the simple division into the two main groups may be retained.

Of the Chroococcaceae, two are pre-eminent as forming water bloom:— *Clathrocystis aeruginosa* and *Coelosphaerium Kützingianum*. The principal part of the scum first collected at Madison consisted of the former species (Fig. 8), though the latter (Fig. 7) was also present.

What have usually been called *Anabaena flos aquae* and *A. circinalis* are, in their several forms, the commonest of the Nostochineae that occur under similar circumstances. A small part of the Madison scum of 1882 was composed of sterile plants apparently of *A. flos aquae*, which, with a little of a smaller *Anabaena*, occurred intermingled with the *Clathrocystis* and *Coelosphaerium*. These species lasted through the summer, the scum which they formed also containing not infrequent threads of *Lyngbya nollei* (Fig. 6), a few stellate plant hairs, and scattering grains of pine pollen. As the

season advanced, the larger *Anabaena* became relatively a trifle more abundant, but for the most part remained sterile.

Examinations were not made for several weeks in August and September, but on the 26th of September, when another sample was taken for the use of a laboratory class, the bloom consisted exclusively of the smaller *Anabaena* (Fig. 5), which I have called *A. mendotae*,[1] a species that continued to appear on the shore at intervals until well into November.

M. Bornet, who was obliging enough to examine specimens of this alga for me, writes as follows: "The *Anabaena* you have sent me belongs to the sub-genus *Dolichospermum* Thwaites, in the sense in which it is understood by Wittroch (Wittroch and Nordstedt: Algæ exsiccatæ, No. 496). It appears to me new, and differs from all of the species which constitute water-bloom in the tenuity of its threads, in the length of its articles and the slenderness of its spores. It is only comparable to *Limnochlide flos aquae* in the dimensions and configuration of the different vegetative and reproductive organs. That you may compare it, I send a tracing from analyses of authentic specimens of *Nostoc flos aquae* Lyngbya [Fig. 1], *Nostoc flos aquae* Agardh [Fig. 2], and *Anabaena circinalis* Rabenhorst [Fig. 3], which is the prototype of the species. Admitting that these three plants are but forms of a single species, as may be inferred from the observations of Wittroch on *Anabaena* (*Dolichospermum*) *hassallii*, your alga still differs from all of them, and is, especially, very distinct from the *Anabaena circinalis* of Rabenhorst."

As a general thing, protracted heat precedes the appearance of the water-bloom, which is most frequent in sluggish or stagnant bodies of water, especially such as are fed by the outlets of bogs, hence the phenomenon is most frequently noticed in mid-summer or later: yet the abundance of the scum in June 1882, shows that a very short period of warmth may suffice for its formation, as the early part of the spring was cold, and there had been but few hot days when it appeared.

Unlike the majority of the algæ implicated, *Limnochlide flos aquae* thrives exceptionally well in cold water, and has even been found luxuriating in the greatest abundance in ice.[2] *Anabaena mendotae*, which first became really abundant after the disappearance of *Clathrocystis coelosphaerium* and the larger *Anabaena*, and lasted until not only the air but the lake itself had become quite cold, appears to resemble it somewhat in this respect.

During the summers of 1883 and 1884, I was absent from the city, but I

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[1] *Anabaena* (*Dolichospermum*) *mendotae*, n. sp — Threads circinate. Vegetative cells slender, usually elongated, especially towards the ends of the filaments, 3–4 × 4.5–12 μ. Heterocysts ellipsoidal or barrel-shaped, 4.5 × 6–7.5 μ. Spores remote from the heterocysts slender, more or less curved, 4.5–7.5 × 20–40 μ, bluish-green, like the vegatative cells (Fig. 5) Forming a copious water-bloom on Lake Mendota, at Madison, Wis., especially abundant in the fall.

[2] Magnus: *l. c.*

am informed that though some water-bloom occurred, and at times became offensive, especially in the latter summer, it was less abundant than in 1882. In 1885 but little was seen. Once or twice toward the end of July the scum accumulated in small quantity, but was quickly dispersed by a change in the wind, and it was not until nearly the middle of August that I was able to collect specimens. On the 10th of August quite a quantity was noticed floating in sheltered places along the University shore, and in the lee of Picnic Point, and more was seen off the shore toward Merrill's Springs, where it had stained the rocks somewhat. This consisted entirely of the *Anabœna* represented in figure 4, in good fruit.

After a warm spring, on my return to Madison, June 6, 1887, I observed a considerable quantity of putrid scum on the shore of Fourth Lake, but a south wind scattered it before specimens were obtained. The succeeding fortnight was hot, and after a couple of calm days, succeeding a strong wind from the northwest, the southern half of the lake was filled with suspended particles about a millimeter in diameter. These consisted exclusively of *Anabœna hassallii*, already in full fruit, the spores with the customary *Sphaerozyga* arrangement, in a collection made June 20th. Subsequently to this date very little water-bloom was seen, and during the entire summer the lake remained unusually free from it until September 7, when I left the city.

The water-bloom of 1886 was also slight. Floating specimens collected in the latter half of August consisted of fruiting plants of the larger *Anabaena*, similar to figure 4, with a small quantity of *Lyngbya nollei.*

The naming of this larger *Anaboena* has been attended with some difficulty. The first specimens collected, which were sterile, were referred to a form of *A. flos-aquae;* but the subsequent collection of material in fruit has shown that this reference was incorrect, if *A. flos-aquae* is understood to be characterized by globose or sub-globose spores,[1] remote from the heterocysts, and hence referable to the sub-genus *Trichormus.* It is, however, identical with the *Nostoc flos-aquae* of Lyngbya of Dr. Bornet's sketch (fig. 1), which would be referred to the sub-genus *Sphœrozyga*, and agrees essentially with the type of *A. hassallii.* I should, therefore, refer our plant to *A. hassallii.* According to Wittrock, this species varies in the relative position of spores and heterocysts as widely as the three figures furnished by Dr. Bornet. Among our Madison specimens, none have been found with the spores remote from the heterocysts, but the spores are not infrequently solitary, as noted by Rabenhorst.[2]

About the middle of August 1886, while rowing across Second Lake (Waubesa), south of Madison, my attention was attracted by very numerous yellowish-green spherules about 1 mm. in diameter, floating at all depths in the water. These proved to be small fronds of *Glocotrichia*

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[1] Cf. for example, Cooke: Fresh-Water Algæ, p. 235, pl. 93, f. 1.

[2] Rabenhorst: Flora Europæa alg. aq. dulc. et submar. II., 195.

pisum. Each consists of a mass of tapering threads arranged radially in a gelatinous matrix, from the surface of which their apices protrude more or less, often rendering the surface bristling. The base of each filament is occupied by a heterocyst, followed by a slender cylindrical spore, above which come a series of vegetative cells gradually decreasing in diameter, until they form a slender colorless point.

This species has been reported from time to time in Europe, under a number of names, and has recently been discussed at some length by Bornet and Flatanet. According to Arthur, who studied a sterile form occurring in certain Minnesota lakes, it is believed to be poisonous to cattle that drink the water containing it. Usually it is found without spores, but, as I learn from M. Bornet, it can readily be kept in the aquarium for several months, during which time the sterile forms usually produce spores.

Gloeotrichia pisum Thur.—Fertile thread, (× 580.)

Frequenters of the seashore are familiar with a slime of a bright peach-color that is abundant in midsummer in and about stagnant pools in salt marshes. This is of the same nature as the scums already referred to, and is caused by what is generally called *Clathrocystis roseo-persicina*, a plant related to the chroococcaceae, but destitute of chlorophyll, and recently transferred to the bacteria, and placed under the genus *Beggiatoa*, by Zopf. Species of *Trichodesmium, Spirulina, Lyngbya, Oscillaria*[1] etc., which usually grow at first on the bottom, frequently break free and float in a gelatinous film of a yellowish, blue-green, violet or reddish color; and diffiused threads of some of the species of these genera more rarely form a true water-bloom[2] *Limnochlide flos aquæ* is also a common Nostochineous species that forms a water-bloom. In Europe, water is occasionally fouled, if not discolored, by *Leptomitus lacteus*, one of the Saprœgnicæ, and *Crenothrix Kühniana*, one of the bacteria closely related to *Beggiatoa*. *Beggiatoa alba* is also abundant in sulphur springs, hot ditches and stagnant bays, but is usually attached to the bottom, floating only exceptionally.

Certain species of *Peridinium* and *Euglena*, which have been regarded as infusoria until recently, but are now classed by Klebs with the algæ, are quite frequent on the water and mud of stagnant ditches, etc., in spring, imparting to it a bright red or green color. A species of the

[1] The largest of these, *Oscillaria princeps* Vauch, with filaments 50–57 μ in diameter, is found floating in such masses every season in a brook near the city.

[2] I have in my herbarium a specimen of *Oscillaria* (or *Beggiatoa*), *diffusa* Farlow, the oscillating threads of which, composed of cells 4–5 μ in diameter and 2–4 μ long, gave a pronounced purple color to the water of Jamaica Pond, Mass., in the spring of 1884, as I am informed by Dr. Farlow.

former genus was so abundant in the drinking water of Baltimore as to attract attention in midwinter, a few years since.[1]

In closing, a word may be added concerning certain objects to some extent resembling green tomatoes, that have been noticed a number of times on the bottom of the shallower parts of Third Lake, and of the larger pools along the railroads. These are of rounded form, more or less lobed, and of a pale bluish-green color. Their texture is rather firm, so that they retain their form when taken from the water, though they may be easily crushed to a formless mass of jelly, and when exposed to the air for a few days dry down into a thin film.

These bodies are colonies of *Nostoc verrucosum* Vauch., one of the Nostochineæ, which is also found in the old world. Under the microscope they are seen to consist of numerous contorted threads of a blueish-green color, imbedded in a colorless jelly that holds them together and gives form to the frond.

The following list of papers referring to the water-bloom is confessedly incomplete, but it will serve as a nucleus for other references. Only the principal papers treating of the recurrence of bacteria in quantity have been included; other references may be obtained from them. It should be added that comparatively few of the papers referred to have much botanical value.

On the flora of ice and snow fields, in Alpine and Arctic regions, which often produces striking color effects, see Wittrock, in Nordenskiold's Studien und Forschungen, veranl. d. meine Reisi im hohen Norden, Leipsic, 1885, where a bibliography of the subject is given.

The diatomaceous origin of the discoloration of Arctic seas is discussed by Robert Brown, in the Transactions of the Botanical Society of Edinburgh, IX, 1867–8.

Archer: An Oscillaria of Australian seas occurring in large quantities. (Quart. Journ. Mic. Sci., XVII, 214; Bot. Johresb., VI, I, 403).

Arthur: A supposed poisonous seaweed in the lakes of Minnesota. Proc. Am. Ass. Adv. Sc., 1883, XXXII, p. 305—abstract.

Arthur: Some Algæ of Minnesota supposed to be poisonous. (Bull. Minn. Acad. Nat. Sci., XI, 3; Fourth Rep. Univ. Minnesota, suppl. i, Rept. Dept. Agr., 1887, 97.

Arthur: Second Report on some Algæ of Minnesota supposed to be poisonous. Fourth Report Univ. of Minn., suppl. i, 109.

Berkeley: Gleanings of British Algæ. (Supplement to Sowerby's English Botany, 1883).

Bornet & Flahanet: Sur la determination des rivulaires qui forment des fleurs d'eau. (Bull Soc. Bot. de France, 1884, 76.)

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[1] As this is going to press, I notice a record of the occurrence of certain zoospores in such quantity as to cause a water-bloom (De Toni, Shrovo Gion, Bot. Italiano, xx. 295), in which references are given to several other Italian papers on this subject.

Braun: Ueber Chytridium, eine Gattung einzelliger Schmarotzergewachse auf Algenund Infusorien (p. 50). Abhandl. Berlin, Akad., 1885, 21).

Cohn: Ueber zwei Folle von sogenanlüter wasserbüthe durch Algen veranlasst. (Sitzber. bot. sect. Schles. Ges für Vat. Culture, Nov. 15, 1877; Hedingia, 1877, 188; Bot. Jahresb., v, 31).

Cohn: Rivulanria flintaus ad int. (Hednigia,1878, **1**; Bot. Jahresb., vi., **1**, 402).

Cohn: Untersuchungen über Bacterien. Verwandschaft von Ascococcus mit Chroococcaceen. (Beite. zur Biol der Pflanzen, I., **3**, 155 *et seq.*).

Cooke: (British Freshwater Algae, 235, 237, 240, 249, 278).

Cooke: Breaking of the meres. (Grevillea, X., 111; Am. Monthly Micro. Journal, III., 94; Bot. Jahresbericht, X., **1**, 330).

Coppinger: Oceanic phenomena. (Nature, XXIII., 482; Bot. Jahresber. IX, **1**, 370).

Dichie: Botanist's Guide to Aberdeen, 1880, 310.

Dolley: On a cilio-flagellate infusorian recently observed in Baltimore drinking water. (Johns Hopkins Univy. circulars, III., 60).

Drummond: On a new Oscillatoria, the coloring substance of Glaslough Lake, Ireland. (Ann. Nat. Hist., I., 1).

Ehrenberg: Antheil mikroskop. Organismen am Verschlämmen der Seehafen in Wisman und Pillau sowie am Schlich des Flussbettes der Elbe, und über die Miteverbung ähnlichen Erscheinung an der Bildung des Nilbodens. (Monatsber. Berlin, Akad., 1841, 127; 201).

Farlow: On certain algæ in Hom Pond. (Proc. Boston Soc. Nat. Hist., XIX., 47; Bot. Jahresber. VII., **1**, 460).

Farlow: Remarks on some algæ found in the water supplies of the city of Boston. Bull. Bussey Inst., Jan., 1877).

Farlow: Paper on some impurities of drinking water. (Rept. Mass. Board of Health, etc., I., 131.)

Farlow: Notes on fresh water algæ. Bot. Gay., VIII., 224, 246.

Farlow: Relation of certain forms of algæ to disagreeable tastes and odors. Proc. Am. Ass. Adv. Sc., XXXII., 1883, 306.—Abstract.

Farlow: On the nature of the peculiar reddening of salted codfish during the summer season. (Rept. U. S. Fish Commission, 1878, 969). See also Revue Mycologique, VI., 197, VII, 17).

Farlow: Vegetable parasites of codfish. (Bull. U. S. Fish Comm., VI., 1, 1886).

Fleischer: Uber ein massenhaftes Aufstreten von Protococcus roseopersicinus Ktz. (Hedingia, II., 37.

Francis: Poisonous Australian lake. (Nature, XVIII, 11; Bot. Jahresb., VI., **1**, 402).

Giard: Etude sur une bactérie chromogéne des laux de rouessage du lin. Rev. Sci. Nat., V. *Fide* Zopf.

Girod Chantrans: Recherches chemiques et microscopiques sur les conferves, etc. (Paris, Ann., x.—Vide Schultz, 495).

Gobi: Mittheilungen über Rivularia flos aquae Gobi. (Arbeiten Ges. Naturf., St. Pétersb., X.; Bot. Zeitung, 1880, 478).

Gobi: Ueber eine die Erscheinung der Wasserblüthe im Meerwasser hervorrufende Rivularia. (Hedingia, 1878, 33.—Nachtrag. *l. c.*, 49; Bot. Jahresber., VI., **1**, 402).

Harz: Ueber die im veriflossenen Jahre beobachtete Trübung des Schlierseewassers. Bot. Centralblatt, 1887, XXX, 286, 331.

[Hitchcock]: Water colored by Algae. (Amer. Monthly Micr. Journal, III., 94).

Humboldt: Bericht uber die natur hist. Reisen der Herrn Ehrenberg und Heimpridt.—*vide* Schultz, 495.

Magnus: Das Auftreten von Aphanizomenon flos aquae (L.) Ralfs in Eise bei Berlin. (Ber. deutschen Bot. Gesellsch., I., **3**, 129; Bot. Jahresb. 6, XI., **1**, 293).

Montague: Mémoire sur le phénomène de la coloration des eaux de la Mer. Rouge. (Comptes rendus, July 15, 1844; Ann. Sci. Nat., Ser. **3**, II., 332).

Montague: Note sur un nouveau fait de coloration des eaux de la mer par une algue microscopique. (Comptes rendus, Dec. 16, 1846; Ann. Sci. Nat., Ser. **3**, VI., 262).

Montague: Résumé succinct des observations faites jusqui ici sur la rubéfaction des eaux. (Mém. Soc. de Biologie, I., 59).

Olivier: Recherches sur la rubéfaction naturelle de l'eau. (Bull. Soc. bot. de France, 1881, 216).

Pavesi: Faune pélagique des lacs de Teasin et d'Italie. (Archives des Sci. phys, et nat., Geneva. Ser. 3, IV., 151; Bot. Jahresb., VIII., **1**, 538).

Phillips: Breaking of the meres. (Grevillea, IX., 41).

Phillips: The breaking of the Shropshire meres. (Trans. Shropshire Archaeol. and Nat. Hist. Soc. [1884?], 1).

Ralfs: On the Nostochineae. (Ann. and Mag. of Nat. Hist., Ser. 2, V., 321).

Ray Lankester: On a peach-colored Bacterium. (Quart. Journ. Micr. Sci., *n. s.*, XIII., 408).

Ray Lankester: Further observations on a peach or red-colored Bacterium. (Quart. Jour. Micr. Sci. *n. s.*, XVI.).

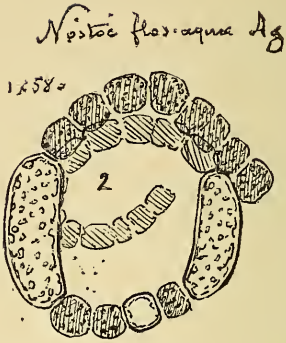
Richter: Ueber die in den Enterichelungskries von Beggiatoa roseopersicino geborenden seitheirgen Algenspecies. (Hedingia, 1884, 177).

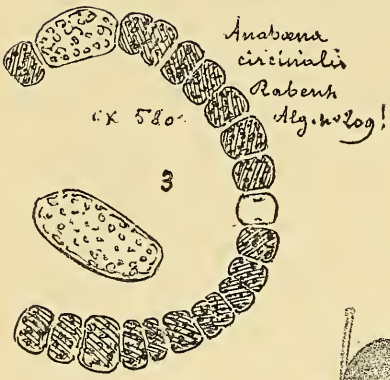
Richter: Microcystis Kütz., ein einzuziehendes Algengenus. (Hedingia, 1885, 18).

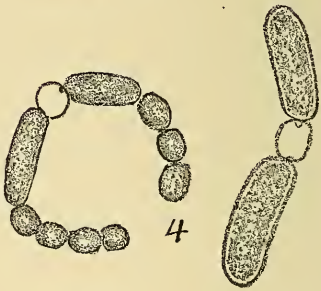
Schneider: Mittheilung über die grünen und gelben Streifen in dem Meer von Java. (Naturk. Tydskr f. ned. Indie, 1873, XXXIII., 302; Lotos, 1875, 63; Bot. Jahresber., III, 41).

Schnetzler: Ueber eine rothe Tärbung des Bretsees (lac de Bret), Bot. Centralblatt, 1887, XXXI., 219.

Nostoc
flos aquæ
Lyngb.!
1 x 580
1


Nostoc flos-aquæ Ag.!
1 x 580
2


Anabæna
circinalis
Rabenh.
Alg. exsicc.!
c x 580
3


4

5

6

a
b
7
c

a
8
b

Schultz, C. H.: Die Fortpflanzung und Ernährung du Pflanzen, 1828, 495.

Stalher. Report on the Waterville cattle disease (see Arthur). Fourth Rep. Univ. Minnesota, Suppl. 1, Rep. Dep. Agr. St. Paul, 1887, p. 105.

Thompson: An Alga which colors Ballydrain Lake (Ann. Nat. Hist., 1840, 75).

Treichel: Ueber Polycystis aernginosa Kütz, als Ursache von roth gefärbtem Trinkvasser, (Ber. 2 Versamml. Westpreuss. Bot. Zool. Vereins zu Marienweider, am 22 Juni 1879.—*fide* Bor. Jahresber., VII., 1, 486).

Weisse: Monas Oheini. (Bull. Phys. Math. Acad. St. Petersburg, III., 310).

Weisse: Zereite Verzeichniss St. Petersb. Infusorien. (Bull. Phys. Math. Acad. St. Petersburg, III., 333).

Wittrock: Anabaena (Dolichospermum) Nassallii (Kütz.) Wittr. (Wittroch & Nordstedt's Algae aqæ dulcis exsiccatæ, No. 496; Bot. Notiser, 1882, 58; Bot. Jahresb. X. 1. 330; XI. 1, 244, 280.)

Wolle: Fresh Water Algæ. Bull. Torr. Bot. Club, VIII.,38; and Fresh Water Algæ of the United States, Bethlehem, 1887.— various places.

Wood: Contribution to the history of the fresh water algæ of North America, p. 39, etc. (Smithsonian Contributions, 1872).

Zopf: Die Spaltpilze, 1883, 74 *et. seq.*, where other references concerning Beggiatoa, etc., are given.

Description of Plate X.

1—4. *Anabaena hassallii* (Kg.) Wittr.

1. Filament of *Nostoc flos aquae* Lyngb. (× 580). From a sketch kindly furnished by Dr. Bornet.

2. Filament of *Nostoc flos aquae* Ag. (× 580). From sketch by Dr. Bornet.

3. Filament and spore of *Anabaena circinalis* Rab. (× 580). From tracing by Dr. Bornet, from analyses of Algen Sachsens, No. 209.

4. Fertile filament and two mature spores of *Anabaena* (*sphaerozyga*) *flos aquae* (Lyngb.) (× 580). From Lake Mendota.

5. Two filaments and mature spore of *Anabaena mendotae* Trelease. (× 580). From Lake Mendota.

6. Part of filament of *Lyngbya wollei* Farlow. (× 580). From Lake Mendota.

7. *Coelosphaerium Kützingianum* Naeg. From Lake Mendota.—*a*. Fronds (× 25). *b*. Group of cells as seen from the surface (× 580). *c*. Cells as seen in radial section of frond (× 580).

8. *Clathrocystis aeruginosa* (Küttz). From Lake Mendota.—*a*. Frond (× 25). *b*. Single cells (× 580).

THE VILLAGE COMMUNITY AND SERFDOM IN ENGLAND.

By Prof. WM. F. ALLEN.

The existence of village communities with collective ownership of land, in England, is a fact of comparatively recent discovery. Long after von Maurer and the writers of his school had submitted the subject to an exhaustive investigation, in relation to the Teutonic countries of the continent, it was believed that England afforded no examples of the system. The eye of the American traveler upon the continent is constantly struck by the ribbon-like strips which almost everywhere testify to a system of occupation and cultivation of land differing widely from that of his own country; while in England the fields, of irregular size and shape — although enclosed with hedges instead of stone walls and rail fences — are precisely what he is familiar with at home. It was only after the inquiry was, so to speak, completed for the continent, that a German scholar, Prof. E. Nasse, of Bonn, took it up in relation to England, and showed that here, too, the system of village communities, with an open-field system of husbandry, was the prevailing one during the middle ages.[1]

The line of inquiry entered upon by Prof. Nasse in the work referred to, was shortly after followed out by Sir Henry Maine in his "Village Communities," (1871); and more recently Mr. Frederick Seebohm, in his "English Village Communities," (1883), has given a description and analysis of this institution which could not be surpassed in thoroughness and lucidity. Since the publication of this work, in 1883, there has no longer been any room for difference of opinion as to the existence of village communities in England, or indeed as to their organization in almost the smallest detail. A new controversy has, however, been suggested by his work. Mr. Seebohm holds that these village communities were not, in their origin, groups of free peasant proprietors, reduced by gradual steps to a condition of serfdom, as the accepted theory maintains, but that serfdom was their original condition, there having been no essential change in this respect from the first settlement of England down through the feudal period. This view is closely connected with Mr. Seebohm's theory of the primitive aristocracy of

[1] See his treatise, translated and published by the Cobden Club: The Agricultural Community of the Middle Ages, and Inclosures of the Sixteenth Century in England. London: Williams & Norgate, 1872.

the Germanic nations, which I discussed in a former paper.[1] Holding that serfdom was the original condition of the mass of the German people, he naturally holds that the same was true of the English settlers. And it must be conceded that, if his theory is true for Germany, it must perforce be true for England, while the converse does not hold. To prove the primitive democracy of the Germans does not prove a primitive democracy for the English, for the reason that their migration and conquest of a foreign land may have worked a fundamental change in their social institutions.

The question to be considered is, it will be seen, not whether the village community existed or not; that has been placed beyond controversy by Messrs. Nasse and Seebohm. It is, whether it was a free or a serf community; and the question resolves itself at once into a larger one, as to the origin of serfdom in England. This will form the subject of the present paper.

It has generally been held that serfdom in England was in part at least the result of a gradual deterioration in the condition of an originally free peasantry — that while no doubt some serfs were in their origin emancipated slaves, and others conquered Britons, while others again were brought over as serfs by the English conquerors; nevertheless the largest portion of them were the descendants of the conquerors themselves, the rank and file of the invading armies, who had sunk by degrees to a condition not much above that of the native Britons. This view is disputed by Mr. Seebohm. According to him there was no large body of free Germans, but the invading armies were composed of chieftains with servile followers, whom they settled at once as serfs upon their estates. The manorial system of the middle ages, therefore, existed from the first; the free Angle or Saxon was the lord of the manor, or thegn, the serfs whom he brought with him, or found already upon the soil, were the same body as the villeins of the feudal period.

His line of argument is as follows: Finding serfdom to be the condition of the peasantry in the middle ages in association with the village community, he traces both institutions back by an inductive process of remarkable ingenuity and cogency, to the reign of Alfred, at the beginning of the tenth century, at which point of time he shows that the condition of the peasantry did not differ essentially from what it was in the reign of Edward I., four hundred years later. Further back than this he is not able to go with the same thoroughness of detail, for the want of documentary evidence; he finds, however, passages in the laws of the seventh century which appear to support his view, and maintains that if we find no change in tracing the institution back six hundred years to the time of these laws, we should not be likely to find any change if we could trace it back still further for the much shorter period of two hundred years or so, to the first settlement of the Angles and Saxons in Britain. This argument is still further strengthened by the assertion that serfdom not merely existed in the

[1] See Transactions of the Wisconsin Academy, Vol. VI.

tenth century (and probably in the eighth) as well as in the thirteenth but that it was more complete and harsh at the earlier date than at the latter. If these conclusions are correct, if the agricultural population of England was in a condition of serfdom uninterruptedly from the eighth century to the thirteenth, and if its early form was more severe that its later, he must be admitted to have made out his case.

As to the first point, it should be noted that he has *proved* the existence of serfdom only as far back as the tenth century; its existence at an earlier date is only an inference, partly from analogy, partly from evidence which, as will be shown further on, proves the existence of the open-field system of husbandry, but not of serfdom. The positive evidence goes no further back than the time of Alfred. Now the interval between Alfred and the original settlement of the Anglo-Saxons in Britain is just about as long (400 years) as that between Alfred and Edward I.; moreover, it is an important consideration that the years directly following the conquest would be likely to witness far more rapid and radical changes than the ater period.

The second point in his argument, that serfdom is found to be more harsh in its type as we trace it further back in time, requires a careful examination, being opposed to the accepted view, and resting upon evidence of a rather doubtful character. We have numerous documents belonging to various point of time from the tenth to the thirteenth century, which contain a detailed enumeration of the duties and obligations of serfs, as well as the amount of land they held. Now the obligations, so far as they are specifically enumerated, are much more numerous and burdensome at the later period than at the earlier: but, at the earlier date, we find, in addition to the specific obligations, such general and indefinite ones as: "to work as the work requires," and "every week do what work they are bid." In such general and unlimited obligations as these, he says, consists the essence of servitude.

This argument requires that the obligations, beginning in the tenth century with unlimited liability to labor, should go on regularly lessening in amount and becoming easier through the feudal period. The contrary is, however, the case. Leaving out of account for the present the indefinite expressions just cited, to which we shall return presently, we find the precisely enumerated obligations to be less in the tenth century than in the twelfth, and in the twelfth century again to be less than in the thirteenth. That is, while there is an uninterrupted continuity through these four hundred years in the organization of the peasantry and the general character of their obligations, these obligations, as specified in detail, appear to have been steadily increasing during this period. Even the example given by Mr. Seebohm (p. 157), of the manor of Tidenham at the two periods, sustains this view, except for the phrase, "work as the work requires," at the earlier period; and a comparison of the duties specified in the *Rectitudines singularum personarum* with the numerous descriptions in the *Rotuli*

hundredorum or the Cartularies in the reign of Edward I., shows a much larger amount of required labor at the later period.[1]

In one instance we have positive evidence in detail of this increase in burdens. The residents of Weston, in Bedfordshire, made a complaint to the officers of Edward I. that, in the reign of his grandfather, King John, they were accustomed to labor in autumn only for three harvest days, on which days they were provided with food at their lord's table, one day of fish and two of meat. But William de Bokland, to whom King John granted the estate, increased the aforesaid service by one additional day, at the lord's table. Afterwards the aforesaid manor came to John Tregoz, who augmented the service to such a degree that now they perform ten days' work in autumn at their own providing, and one day besides.[2] Here we have on record an actual example of an abuse of power by the feudal lord, in increasing the burdens of his serfs, such as we must suppose to have been common in those evil days. It is a significant point that the extortions here described were not the work of one man, but of three successive proprietors.

As to the phrase in question — to do "every week what work they are bid" — it is best explained as a general authority to call upon them when there was need, with an understanding that no unreasonable demands should be imposed upon them. In this respect this obligation resembles the feudal aids and tallages, which also were levied at discretion, but were understood to be only occasional, and implied nothing servile in the relation. Feudal aids and tallages were nevertheless liable to abuses and extortion by reason of their indefiniteness, and were at last defined by law. So in like manner the indefinite obligations in question gave opportunity for arbitrary exactions, like those in the manor of Weston, described above. It may have been the case, too, that such obligations as these were not universal, but peculiar to such and such an estate. The tenth century document, *Rectitudines singularum personarum*, says distinctly that the obligations vary, being lighter here and heavier there; but what it describes as the usual ones are much less in amount than what was common in the

[1] Compare, for the earlier period, the *Rectitudines singularum personarum*, the Codex Diplomaticus, No. 977, and the illustration given by Mr. Seebohm, p. 157: for the twelfth century, the Domesday of St. Paul, and the Abingdon Cartulary, Vol. II, p. 301; for the close of the thirteenth century the documents are very abundant, the most numerous examples being in the *Rotuli Hundredorum* and the Gloucester Cartulary, Vol. III.

[2] In tempore Regum Henrici et Johannis dicti homines non consueverunt operari in autumpno nisi tantum tres messes in quibus diebus debebant exhiberi in cibis et potibus ad mensam domini una die in esu piscium et aliis duabus in esu carnium. Postmodum Willelmus de Boclond augmentavit dictum servicium et per ipsum crevit per unam diem messis ad mensam domini. Postmodum Hamo le Crevequer tenuit dictum manerium in eodem statu toto tempore . . . Item deinde venit dictum manerium ad manus Johannis Tregoz qui praedictum servicium augmentavit in tantum quod modo fiunt decem operaciones in autumpno ad mensam suam. Item praeter istam operacionem exigitur ab hominibus praedictis una water-bederipe et fit. Et tunc bibunt aquam, et hoc crevit primo per dictum Hamon, etc. *Rotuli Hundredorum*, i. 6.

thirteenth century. It should be noted also that the *Rectitudines* speaks distinctly of the tenants in question as freemen.[1]

I cannot, therefore, concede to this part of Mr. Seebohm's argument the weight which he claims for it. He does not seem to me to have proved that the obligations were less in the thirteenth century than in the tenth; on the other hand the evidence seems to me to lean strongly the other way. But he has proved, and it is a fact of great importance, that the character of the obligations, and the status of the peasantry, did not, so far as our information goes, differ essentially in the tenth century from what we find in the thirteenth. It is, therefore, perfectly legitimate on his part to infer that this condition of the peasantry, found alike in the thirteenth and in the tenth century, probably existed in the earlier centuries also. The inference is, however, only a probable one, in the absence of direct evidence, and direct evidence is wanting. For the period before the time of Alfred, he is obliged to have recourse to indirect evidence, in the assumption that serfdom and the "open-field husbandry" went together.

Up to this point he has traced the open-field system and serfdom step by step, accompanying each other hand in hand. Beyond this point he is not able to trace serfdom, but the open-field system is traced back at least two centuries further, and he says that, as it has always carried serfdom with it in the later period, it may fairly be assumed to do the same thing in the earlier period. "The community in villenage," he says (p. 105) "fitted into the open field system as a snail fits into a shell." But it is by no means clear that a free community might not have fitted into this shell equally well, as, indeed, the prevailing theory holds. The only argument to prove that the community could not have been a free one is (p. 177) that the Teutonic custom of dividing estates equally among heirs would have led to endless and intricate subdivisions of land. But this is exactly what we find to have been the case. The virgate or "yard-land," which he assumes to have been the regular peasant's holding, and which as a matter of fact was the usual one in the thirteenth century, was the fourth part of a hide; and it is generally held that the hide, not the virgate, was the original holding. And at any rate, in the thirteenth century, we find tenures of half and quarter virgates, and even smaller aliquot parts, by the side of the regular tenure of the virgate;[2] exactly the condition of things which Mr. Seebohm says would have come about.

To carry back, therefore, the open-field system to the seventh and sixth

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[1] *Sicut omnis liber facere debet.*

[2] For example, in the manor of Broctrope (Gloucester Cartulary, iii, p. 140), I find among the freeholders two tenants holding entire virgates, and five holding half virgates; and among the customary tenants one with a virgate, nine with half-virgates, two with quarter virgates, and five with an amount of land equal to a sixteenth of a virgate, these differences evidently coming from the sub-division of the original hide. For other examples, see my paper on Rural Classes in the Thirteenth Century, Vol. II, of the Transactions of the Academy: that the socage freeholds were originally servile holdings is shown in my paper on the Origin of the Freeholders, Vol. IV, of the Transactions.

centuries, as Mr. Seebohm does by almost certain inference, is a valuable contribution to our knowledge; but that serfdom went back with it is an unwarranted inference. The question of freedom or serfdom is the fundamental one, that of land tenure or husbandry being really but secondary. To this fundamental question of status, therefore, we will now apply ourselves, leaving that of land occupation aside for the present.

At this point it must be conceded, as I have said before, that the existence of a large body of free peasants in the Germanic nations of the continent, which I consider to be fully proved, does not necessarily prove the existence of the same class in England. The Angles and Saxons settled forcibly and very slowly in Britain, and it is not in itself impossible that the whole body of the Conquerors became a landed aristocracy in their new home, establishing such a system of manors, with a population of serfs upon them, as we find in later centuries. This is Mr. Seebohm's view. But the probability is the other way. The Angles and Saxons did not enter Britain as the Normans did afterwards, as a handful of conquerors, ruling over a subject people. They came *as a people*, bringing their wives and children with them, not *as an army*; and with regard to the Angles we are expressly told[1] that they left vacant the country which they had formerly occupied — the entire people having migrated. Moreover the native inhabitants were *as a people* exterminated; in the eastern parts of the island their language, their religion, and so, far as we can judge, their institutions and customs disappeared. If the invaders established a system of serfdom in Britain, they must have brought the serfs with them, otherwise the servile population would have had the preponderence of numbers, and the resulting community would have been, as in the case of the Normans and the Franks, the native population with an admixture of the conquerors, instead of — as the language shows to have been the case — the conquering population with an admixture of natives. Now the Germans had in their native land a class of serfs called *lidi* or *lazzi*, and the Anglo-Saxon laws mention a similar class called *laet*, whom we must suppose to have been the serfs (*lidi*), brought with them by the invaders. These *laet*, the serfs of the Anglo-Saxon period, Mr. Seebohm suggests (p. 175), may have been identical with the *villani*, who were the serfs of the later middle ages. This cannot, however, be the case, as the *villani* are invariably identified with a quite different class, the *ceorls*.

This brings us to the most fundamental question in the subject under consideration: Were the *ceorls* of the early period a free or a servile class? Two things are entirely certain: first, that the Anglo-Saxon *ceorls* were the *villani* of the Latin documents: secondly that the *villani* of the later middle ages were serfs. The point at issue is whether these *ceorls* were originally serfs, as Mr. Seebohm's theory would require, or became serfs by a gradual process of deterioration, as the common theory holds. I shall en-

[1] *de illa patria quae Angulus dicitur, et ab eo tempore usque hodie desertus inter provincias Jutorum et Saxonum erhibetur. Beda. Hist. Eccl., i*, 15.

deavor to show: first, that the *ceorls* of the early Anglo-Saxon period were freemen; secondly, that the *villani* of the later period were not always serfs, there being found some survivals of their original free condition.

The first thing to be noted is that, as has been already pointed out, there was, in the early Anglo-Saxon period, a class known by the name of *laet*, who were undoubtedly serfs, the *lidi* of the continent. They had below them the slaves, *esne* and *theow*, and above them the *ceorls*. Now as the *ceorls* certainly ranked above this servile class, it may be assumed that they were themselves probably free. This probability is made stronger by the consideration that the Saxons of the continent had a class of common freemen intermediate between the *lidi* or serfs and the *edelingi* or nobles, a class which has no representatives among the Anglo-Saxons unless in the *ceorls*, the class under consideration. This class upon the continent was called *frilingi*, and in Anglo-Saxon also we meet the *friman* (freeman)[1] although this term is for the most part superseded in the early Jutish laws by the Scandinavian word *ceorls*.

The probability is therefore that the *ceorls* were a free class. We will proceed, however, to examine the actual uses of the word, in order to determine whether this probability is sustained by facts. First we will take up the poems of Beowolf, a work which, whatever its date and place of composition. unquestionably presents the most ancient picture in existence of the institutions, condition and manners and customs of the Anglo-Saxons. In this poem I find the word *ceorl* six times. In none of these is it applied to a servile class, or even used in a disparaging sense. Twice (vv. 416 and 2,972) it is used of princes; in three cases (vv. 202, 908, 1,591) of the people in general, and in the sixth case (v. 2,444) of a man of the people. If it has one meaning that could apply to all these cases, it is perhaps *man.*[2]

We pass next to the Anglo-Saxon codes of law. In the earliest of these laws, those of Ethelbert of Kent (about 600) *ceorl* is several times used as equivalent to *man* or even *husband*. It is also used to designate a legal class below the King and *eorl* (officer). The King's *mundbyrd* is placed at 50 shillings, the eorl's at twelve, the ceorl's at six. The ceorl was therefore a man of standing. He even had other men under his protection. Section 16 speaks of his cup-bearer, *birele*, section 25 of his *hlaf-aeta* "loaf-eater" or dependent—the correlative of *hlaford* (lord) or "loaf-giver." The ceorl could therefore be the lord of another man. Section 17, following directly upon the mention of the ceorls' *mundbyrd* and *birele*, speaks of a *man's tun* or estate, as it has before spoken of the King's and the corl's *tun*;

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[1] Leg. Aeth. 24, 27, 29, 31.

[2] It should be noticed that in the *Rigs-mal*, the allegorical poem which treats of the origin of the Scandinavian classes, *Karl* (*Ceorl*) is the common freeman, "the red-haired and ruddy cheeked lad with piercing eyes," whose sons were "Freeman and Braveman, Hold, Thane and Smith, Broadshoulders and Bonde [*Peasant*]" etc. The corresponding German word *Kerl* has a somewhat disparaging signification, while the English word *churl* is significant of the degradation which the class sustained in England.

evidently the *man* here is the *ceorl;* the ceorl could therefore have an estate of land.

The later laws of Kent contain nothing that adds to the evidence here given. The next stage in the inquiry is the laws of Ine of Wessex, about 700, that is, about 100 years after those of Ethelbert, and 200 years after the first settlement of Wessex. In these laws we find clear recognition of the ceorls as a free class, inferior to the noble class of *sithcundmen.* The ceorl's fine for neglecting military duty is 30 shillings, that of the *sithcundman* being 60 or 120, according as he had land or not (§ 51). Now by Germanic law none but freemen could render military service. Therefore the ceorl was a freeman. Again, in accusations of homicide, he is placed in regard to compurgation on precisely the same footing with the *sithcundman* (§ 54). On the other hand a certain degradation is clearly visible, in the penalty of amputation of hand or foot, inflicted for certain offences (§§ 18, 37). It would appear also that the ceorl was already required, or at least expected, as he certainly was afterwards required, to have a lord; sections 37, 38 and 40 treat of the ceorl, and between them comes § 39, referring to "any one" running away from his lord — which would certainly seem to mean "any ceorl."

There is another passage of the laws of Ine (§ 67), brought up by Mr. Seebohm, as a proof of the existence of serfdom at this period, but which rather shows that it was in the process of introduction, than that it was already existent. I give his translation. "If a man agrees for a yard-land or more at a fixed gafol (rent) and plough it, if the lord desire to raise the land to him *to work and to gafol* he need not take it upon him if the lord do not give him a dwelling." This statute testifies to the practice of exaction and encroachment by which tenants were converted into serfs, a process well attested at this very period in the Frank monarchy. It is clear that the peasants (assuming them to have been originally free), had already in large part been reduced from proprietors to tenants, the lands were rapidly being absorbed into large manorial estates, and by the same process their proprietors were becoming tenants; the next step was to convert them from free tenants into serfs.

At about this period — the close of the seventh century — belong the earliest (except three or four) of the charters and land grants, which exist in great abundance, and afford the most valuable material for the study of early English social and economical relations. In them we find that the grants consist regularly of estates with their tenants;[1] and the size of the

[1] The charters in question begin in the reign of Ethelbert of Kent, the first Christian king, in the year 605. In all his charters the grants are merely of land — *aliquantulum telluris mei* (a little bit of my land) Thorpe's *Codex Diplomaticus*, No. 1; *aliquam partem terrae juris mei* (a certain part of the land under my jurisdiction), No. 2; *villam nomine Sturigao* (an estate named Sturigaw.), No. 4. A charter of his son Eadbald (No. 5) says *quandam partem terrae regni mei*, xxx *aratrorum* (a certain part of the land of my kingdom, 30 plough-lands). It is not until the close of the century, that the land is defined as of so many occupants; the first is (670) No. 7, *unum cassatum* (one cottager). From this time

estates is regularly estimated by tenants — *cassati*, *manentes*, *tributarii*, sometimes *mansa* and *hida*, all these terms being used as equivalent.[1] This shows that the peasants were at this time largely tenants upon the estates of others; it does not show that they were originally so, or that they were serfs. That they were still personally free, although upon the point of losing their freedom, is, I think, proved by the evidence which I have brought up: it is a fair inference, from the analogy of other Germanic nations, that their land was also originally their own, and this seems also to follow from the mention of the "mannes tun" (Aeth., 17), when speaking of the ceorls.

After Ine's laws, of about the year 700, there is a gap of nearly two hundred years, until the time of Alfred, in which reign the series of statutes begins again, and continues in an unbroken succession until the conquest. The most important change noted in the new series of laws after this interval, is the uniformity and reiteration with which it is required that every man must have a lord, and the rights of the lord are maintained against the caprice of the man, or the rivalry of other lords. *Omnis homo habeat advocatum suum* (every man shall have his surety) Edward, 1.: *non recipiat aliquis hominem alterius sine licentia illius* (No person shall receive the man of another without his permission), id. 7., are regulations repeated in substance in nearly every body of laws. But notwithstanding the rigid requirement of this submission to a lord, it appears that there still survived a certain freedom of choice in the act: *ne dominus libero homini hlafordsoknam interdicat* (let not the lord prohibit the free man to choose a lord). Here the free status of the man is clearly implied; and in the laws of Alfred we have a number of provisions testifying to the lawworthiness and therefore original freedom of the peasants. *Si quis in ceorlisces mannes flet gefeohte, i. e., in rusticani hominis domus area pugnet* (if any one fights in the court of a ceorl). Section 40. *Ceorli eodorbrece, i. e., rustici sepis fractio* (trespasses upon the enclosure of a ceorl), where the ceorl is placed on the same footing as the king, the bishop, the alderman, etc. Section 10 places the ceorl on the same legal footing with the twelfhynd and sexhynd men, who were thegns. Section 25 speaks of *ceorles mennen*=

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this is the universal method; but there are several expressions which show that it is still the land, reckoned in peasants' holdings, rather than the peasants themselves, that is conveyed by the grant. No. 8, (675) says *quandam terram . . . . id est, decem manentes* (a certain piece of land . . . that is to say, ten tenants). No. 10, *terram . . . xviii manentes continentem* (land containing eighteen tenants.) No. 12, *centum manentes qui adjacent civitati* (100 tenants adjoining the city). No. 33 (691) *terram . . . quadrainta quatuor cassatorum capacem* (land containing forty-four cottagers). No. 40, *quadraginta terrae illius manentes* (forty tenants of that land); and, especially, No. 20, *terra super verticem montis. . . est sub estimatione sex manentium* (land on top of the mountain reckoned to be of six tenants). In all these cases it is clear that measurements of land are in question, and in the last instance it is apparently unoccupied land, roughly estimated in terms of peasant holdings.

[1] " . . . *terram septies quinos tributariorum jugera continentem. Est autem rus praedictum in quatuor villulis separatum . . . quinque manentium . . . decem cassatorum . . . decem mansionum . . . decem manentium.* Cod. Dipl. cxi.

ceorles mancipium (the slave of a ceorl). Sections 11 and 35 are peculiarly significant, as they aim to protect the ceorl and his wife against personal violence; showing that, while they were still free in law, they were nevertheless on the road to serfdom, and were especially subject to abuse by the powerful.

We have thus followed the word *ceorl*, and the class which it designates (the peasants) from the earliest times down to the time of Alfred, exactly the point of time which Mr. Seebohm reached, from the opposite direction. As he traced the manorial organization and a servile peasantry step by step from the time of Edward I. back to that of Alfred; so we have traced a class of free peasants from the time of the original conquest down to the reign of Alfred, and have found it gradually subjected to restrictions and obligations which have converted it into a servile or semi-servile class. Mr. Seebohm's serfs were known as *villani;* the free peasants of the early period were known as *ceorls*; and there is the most indisputable evidence that these are the Latin and the Anglo-Saxon names respectively for the same class; this class was the peasantry, who, by this evidence, appear to have been at first freemen and afterwards serfs.

Undoubtedly there were manorial estates, with serfdom, in the earliest times, existing by the side of the townships of free peasants, and following the same system of open-field husbandry. On the other hand it appears clearly that the entire class of peasants or ceorls was not reduced to servitude. We could not be surprised if no free *villani* or free townships (*villæ*) were met with in the records, for it was only the proprietory townships, or manors (especially those belonging to ecclesiastical proprietors), which had a sufficiently systematic administration, and exercised sufficient care in the preservation of documents, to afford adequate evidence as to their existence and condition. But as a matter of fact there is clear evidence of free peasants and even of free townships in the feudal period. For example: Alvarstoke in Hampshire, at the time of Domesday Brook (i. 41, b.) was held by its own *villani* (*ceorls*), tenants of the convent of St. Swithin, of Winchester. The number of *villani* was forty-eight, and there were no slaves, or tenants of a lower grade (*bordarii*). Two hundred years later their charter was confirmed by the prior of Winchester, to the effect "that they and their posterity (*sequela*) should be forever free and quit from tallages, salt-rent, cherset of hens and eggs and pannage of hogs; should be at liberty to make wills and dispose of their children and avers [*averia*= *beasts*]; . . . all pleas except pleas of the crown should, by consent of both parties, be pleaded and tried without delay in the court of Alwarstoke, in the presence of the prior and his seneschal, according to the law and customs of England, and the usage of the free tenants of the county." This document is fortified by the seal of the community, given by Sir Frederic Madden in the Winchester volume of the Archæological Proceedings as: *Sigill: comune: hominum: prioris: Sci Swithuni: de Alwarestoke.* In 1841 an inquisition declares "that there are no traders in Alverstoke,

and that all live by agriculture and hand labor." Melebroc (Millbrook) in the same county the Domesday record (i. 41, b.) gives as being held by *villani*. Of Ibthorpe we are told: "The people of Ibthorpe are lords of their own manor and to this day exercise their manorial rights."[1] It is hard to explain these cases except as original village communities of free peasants, who, in losing the ownership of their land and becoming tenants, did not lose their freedom or their rights as a community.

I have shown that the Anglo-Saxon *ceorls*, or peasants, were in the sixth and seventh centuries. that is the period directly following their migration to England, not serfs but freemen, possessing houses, lands, serfs and slaves of their own; that at the end of the seventh century, the period of the laws of Ine, they are still distinctly recognized as freemen, but as subject to certain exactions and encroachments on the part of the more powerful classes, which were reducing them to a semi-servile condition, in particular encouraging the practice of *commendation*, or placing themselves under the protection of a lord, and becoming his "men;" and that in the time of Alfred this practice of commendation had become universal and obligatory, and their servile condition distinctly recognized.

In short, the history of the English peasantry in the Anglo-Saxon period, corresponds very closely to that of the same class upon the continent in the same period. In both England and Germany the free peasants appear to have been forced, by the disorders and distresses of society to *commend* themselves, or seek the protection of men higher in station than themselves, The protection was not granted without some equivalent — service, following, surrender of land to be given back again as tenure, requirements of labor, becoming more and more onerous as the relation became more and more fixed, until at last they were stripped not only of their possessions, but even of personal freedom, and reduced to the state of complete serfdom: — not so complete, however, in the case of the English peasants, but that the memory of their original freedom was preserved in the principle that it was only in relation to their lords that they were serfs, and that towards all others they were freemen, having well defined rights before the law, and a recognized place in the constitution.

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[1] Antiquary, February, 1888.

TOWN, TOWNSHIP AND TITHING.

By Prof. WM. F. ALLEN.

The town is in many respects the most characteristic institution of the political system of the northern states of the American Union, and of the primitive constitution of the English people. It may be defined as a territorial district, the inhabitants of which compose a body politic, small enough to allow the immediate participation of all its citizens in the government of its local concerns, and forming an organic part of the structure of the state. Its powers of local self-government are not original and inherent, but derived from the larger body of which it forms a part; they are nevertheless substantial and permanent, in this respect differing from those of the school districts or wards into which the town or city is divided. The City under our system is only a larger and specially organized Town; the Incorporated Village of New York and the West is a peculiar addition to the Town system. not forming structurally a part of it.

The Town. as thus defined, is peculiar to England and the United States, and, in its complete development, to the New England States. In all the other Germanic countries the territorial division corresponding to the Town stopped short of an independent political life, being, from the point of view of the State, nothing but a private corporation for economical purposes, with only inchoate functions as a body politic. In all these countries the Hundred was the smallest district of a public character; just as in our southern states the County is the agent of local self-government. But the County and the Hundred are too large to allow the immediate participation of all the citizens in the transaction of public business. The communities in which these large districts are the only agent of local self-government are necessarily aristocratic in their political character. It was the growth of Feudalism, or the establishment of centralized monarchies. in the Germanic countries of the continent, that checked the development of an institution corresponding to the English Town. In England the growth of a landed aristocracy and of a centralized monarchical power were not early or rapid enough to kill the germs of local self-government, although they seriously interfered with its development.

The political functions of the English towns were so largely obscured during the middle ages by the manorial or feudal organizations to which they were subjected, that there have arisen some doubts as to their extent, and even their existence. Bishop Stubbs, in his "Constitutional History of

England" (Vol. i, p. 82), asserts that (in Anglo-Saxon times) "the unit of the constitutional machinery is the township, the *villata or vicus.*" This is the view which I have already presented; but a review of Stubbs' work in the North American Review (July, 1874), understood to be by the then editor of the Review, Prof. Henry Adams, takes exception to the assertion, saying that the township has no constitutional functions "of any kind, sort or description;" that the unit of the constitutional machinery in England, as on the continent, was the Hundred. "The one permanent Germanic institution," he says, "was the Hundred. The one code of Germanic law was Hundred law, much of which is now the common law of England. The Hundred and its law survived all the storms which wrecked dynasties and Witan. It was the foundation of the judicial constitution under the conqueror as it had been under Cnut and Alfred." The same view is repeated in Prof. Adams' "Essays on Anglo-Saxon Law," p. 32.

That the hundred was the lowest political division in Germany, as Prof. Adams asserts, admits of no doubt. This fundamental fact, together with the non-political character of the lower territorial divisions, is perhaps best formulated by Sohm,[1] who points out that the local governments in Germany were purely private corporations, having no public character or functions. But it does not follow that what was true of Germany was necessarily true of England. England, although a Germanic country, received in many respects a different development from Germany; and it is the essence of Bishop Stubbs' position that this was the case with the territorial organization below the Hundred. As the word "town" (*tun, tunscip*) is peculiar to England, so, it may be, is the thing designated by it. This distinction is supported by Von Maurer, the writer of highest authority upon the genesis of local institutions, who, in his *Einleitung zur Geschichte der Mark, Hof, Dorf und Stadtverfassung* (§ 145, p. 332), asserts that the English institutions differed fundamentally from the German in this respect. When, therefore, Prof. Adams says that such an institution as the one in question "would be quite at variance with all that we know of German law," he appears to stretch the argument from analogy further than is warranted. The very question at issue is whether the development of English institutions did not upon this point depart from German analogy.

I shall speak first of the territorial character of the English towns, and then of their political character; and shall try to show that we are to seek

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[1] The following passage expresses Sohm's theory with great fulness: *Zum grossen Nachtheil der Gesammtauffassung nicht blos der Verhältnisse des fränkishen Reiches, sondern der gesammten mittel-alterlichen Entwickelung wird die Thatsache in der Regel übersehen, dass, der Reichsverfassung der fränkischen wie der deutschen, eine Ortsgemeindeverfassung unbekannt ist. Die Reichsverfassung kennt keine weiteren Zwecke ausser denjenigen, deren Realisirung in Gau und Hundertschaft vor sich geht . . . Die Ortsgemeindeverfassung ist aus keinem anderen Grunde local für jede Ortsgemeinde verschieden, als weil die Ortsgemeindeverfassung aus der autonomen Entwickelung der einzelnen Gemeinden hervorgegangen ist. Die Ortsgemeindeverfassung ist Verfassung nur kraft Corporationsrechts, nicht kraft Reichsrechts. Sohm, (Altdeutsche Reichs und Gerichtsverfassung, I, p. 231).*

for analogies with them, not so much in the institutions of Germany, from which those of England were in a sense derived, as in those of New England, which are simply a continuation of those of England.

That the towns in England formed a complete territorial system as subdivisions of the hundreds, needs no argument, as it is amply attested by mediæval writers and documents. It is a familiar fact that they were regularly represented in the courts of the hundred and the shire. I will also cite the authority of Chief Justice Fortescue, in his *De Laudibus Legum Angliae*, who says that the Shires or Counties were divided into Hundreds, and the Hundreds into Towns or Vills (ch. xxiv). *Hundreda vero dividuntur per villas.* This language indicates clearly that "towns" were in the middle of the fifteenth century territorial divisions of the hundreds; that is, that the entire area of the hundred, and therefore of the county, was divided up into the areas of the several towns composing the hundred. And this is still further shown by his going on to say that under the appellation of towns, "the cities and boroughs are included. For the boundaries of these vills are not ascertained by walls, buildings or streets, but by a compass of fields, large districts of land, some hamlets, and divers other limits, as rivers, water-courses, woodlands and wastes of commons." It is evidently the intention of the writer in these words to contrast the English towns with some other towns, the bounds of which are determined not by natural objects, but by artificial ones; and this object of comparison can be only the walled towns and cities of the continent, especially of France, the country with which Fortescue constantly compares England. Attention is here drawn to the important fact that, whereas upon the continent the municipal system was sporadic, the open country having no institutions of local self-government proper, the English municipal system was continuous, embracing the entire territory of the country. The borough was, as Bishop Subbs says (vol. i, p. 92), "simply a more strictly organized form of the township;" and the city a bishop's seat, with borough organization. And both borough and city made, as Chief Justice Fortescue says, a part of the town system.

This town system was brought over to this country by our ancestors, and put in operation in all the northern colonies. The town system of New England, as a system of territorial areas, is the town system of mediæval England; and when the people of New England had outgrown the town system in its primitive form, they developed a new form of organization on precisely the same lines as the English. The New England "city" (and so the Pennsylvania "borough"), is simply a specially organized town, and forms a part of the town system, just as is the case with the boroughs and cities of Chief Justice Fortescue's difinition. A city is territorially a town. And here, as in the case of so many so-called Americanisms, we have preserved the old English usage, which has disappeared in England itself. The town, in its ecclesiastical organization, was a "parish," and in the sixteenth century the parish organization began to supersede the co-

ordinate town organization for purposes of local self-government.[1] It would seem that in the seventeenth century, when this country was settled, this process had not been completed. The colonists brought with them both institutions, and — as all New Englanders know — the parish and the town were, as a rule, identical in New England as in Old England. But while in New England the ecclesiastical organization became quite secondary, and has now practically disappeared, in Old England the reverse was the case. The parish organization has crowded out that of the town. As an English correspondent writes me: "With us town=market town"— a specially privileged, and I suppose specially organized, class of towns. The towns of the open country are known as parishes, and the functions of local self-government, so far as they continue to be kept up, are administered by the vestry, or parish assembly. Still even now we find a survival of the old usage. The same correspondent writes: "I am talking with the squire; the church bell sounds, and I ask him if he knows why: he replies 'for a parish meeting, I suppose.' Again, in a conversation with a laborer, to the same question he will reply: 'for a town meeting, I suppose, sir.'" Here the primitive term has lingered among the peasantry, while it has been dropped by the aristocracy.

The transition from town to parish, and the equivalency of the terms, as well as the fact of local self-government, to be considered further on, are illustrated by local documents. For example: in the reign of Edward VI., under the influence, I suppose, of the radical reformation of the church favored by that monarch, we have a record of a large amount of church plate and other property sold in the eastern counties, by the authority, as it is stated, sometimes of the town, and sometimes of the parish, showing that the two terms are employed as identical. For example: "Barkinge. Certificat of Church wardens there. We present that we have solde by the consente of thole paryshe a crosse parcell gylte, etc. . . . to Robert Knappe and Roger Hylle of the same towne." "Beccles . . . solde anno primo Edwardi sexti Regis etc, by the Townshype and Churchewardens so moch plate as amounteth to the some of xl l." *East Anglian*, May, 1885. "Churchwardens of Martillesham. . . . goods sold by the said churche Revies and other the hoole Inhitants of the said towne." *id.*, March, 1887. This last instance appears to show an identity of the church-wardens with the mediæval reeve. At a later date we find the village of Exning (Suffolk), which at the close of the sixteenth century "appears" says the correspondent who mentions it, "to have been dignified with the title of 'Town', viz.,

1590.

"Item. pd the xx daye of Aprill for a quarter of wyne for the TOWN xij. d. etc." *id.*, March, 1888.

[1] See Gneist's *History of the English Constitution*, Vol. ii, p. 196. As this great writer is wont to depreciate the popular elements in the English constitution, it is not surprising that he does not recognize the town, *villata*, as a regular part of the machinery of government in the middle ages.

It will be noticed that in these extracts the words "town" and "township" are used interchangeably. This was the case also in the early history of New England. For example: in the Massachusetts Body of Liberties (1641) we find "town" in Articles 16, 50, 51, 57, 62 and 85; "township" in Articles 66, 68 and 84, used with no apparent distinction of meaning. Article 74 couples them together: "the freemen of every town or township." We can perhaps trace a disposition to use the word "town" when speaking of the corporate body, and "township" for territory, e. g., Article 78, where it is forbidden to expend "any town treasure but by the freemen of that township." At present I believe the word "township" is not in use in New England, except occasionally to designate the town from the point of view of the territorial area; never as a body politic. Curiously enough, it is this word, fastened upon by De Tocqueville, that is regularly used by foreign writers to describe the New England *town* system. The term "*township* system" is properly used in this country only for the six-mile square divisions of the public lands, laid out by the government surveys. The states erected out of these public lands have a *town* system of their own, parallel with the national *township* system, and generally coinciding with it in respect to division lines, but not always. For example, the town of Trempealeau, Wis., contains the whole of Township 19, N., Range 9, W., and parts of Townships 17 and 18, Range 9, and 18 and 19, Range 10. In the primitive Anglo-Saxon usage the word "township," *tunscip*, appears to have been regularly used to designate the town as a municipality while "town," *tun*, was the settled portion — what in New England is called the "village" or the "middle of the town."

This distinction is quite in accordance with the etymology of the word. It is well known that "town," *tun*, is the same word with the German *zaun*, hedge or fence. But while the Germans never used the word *zaun* to designate the enclosed (fenced-in) area; the Anglo-Saxons, on the other hand, never used the word *tun* except to designate this enclosed area; the primitive meaning of *enclosing body* having been entirely lost. Now the thing fenced in was the village, or group of houses, which was accordingly the *tun*; and the *tunscip*, or township, was the area of land which belonged with the village as a municipal organization. As a consequence, the word *tun* was popularly applied to any place of collective residence; as where the Saxon Chronicle (Land Ms. An., 584), says: *Ceawlin manige tunas genam* — "Ceawlin took many towns." In the course of time the word *town* appears to have crowded out the more strictly correct word *township*, in the sense of designating the territorial area as a municipality; and in this sense the word was brought to New England by the colonists of the seventeenth century. In this country the meaning of the word is precisely that of Fortescue's time. In England, on the other hand, the modern use appears to be a survival of the loose and popular early usage, as applying to any place of collective residence; being limited in England at the present day to large places.

In limiting the signification of the word *tun,* to designate not the object which encloses (its primitive meaning), but the space enclosed, the Anglo-Saxon agrees with the Scandinavian language, as is the case with so many words and institutions of the early Anglo-Saxon period. The definition of the Icelandic *tun,* as given by Vigfussen, is: "a hedged or fenced plot, enclosure within which a house is built; then the farm-house with its buildings; the homestead." This is precisely the meaning which the word has in the earliest Anglo-Saxon laws, those of Aethelbihrt of Kent; it will be recollected that the settlers of Kent were Jutes, that is Scandinavians, rather than Saxons, like the rest of the migratory tribes. In these laws we read of a king's *tun* (Ch. 5), an eorl's *tun* (Ch. 13), and a "*mannes tun*" (Ch. 17) in all which cases *tun* is clearly the hedged enclosure, the homestead.[1] From the fenced enclosure of an individual homestead or field to that of a village, as in the later laws, is an easy step; or rather the two uses are alike easy transitions from the original signification of the enclosing fence or hedge.

This further extension of the word, however, does not appear to have been made by the Scandinavians of the continent any more than by the Germans. None of the Teutonic nations of the continent appear to have had any territorial subdivision of the hundred, of a substantial, individual, public character. With them the hundred was the unit of the constitutional machinery; and any lesser subdivisions stood to the hundred very much as our school districts or wards do to our towns or cities — as mere shifting administrative districts, having no substantial powers, and not forming a body politic. Scholars are now agreed, as I have already said, that the Dorfschaft was a division of a purely secondary character, for agricultural and economical purposes. Nevertheless it corresponded closely in its origin to the English *township*; and might, except for the early feudalization of Germany, have attained an equal degree of independence. *Dorf.* village, is the exact equivalent in meaning (not in etymology) of the English *tun,* and the affix *schaft* is the English *scip*; so that "township" is in meaning precisely the German *Dorfschaft.*[2]

From the territorial character of the English township, we pass to the consideration of its political character, as "the unit of the constitutional machinery." Direct evidence for this is not very abundant, but seems to be entirely sufficient. I have already spoken of Chief Justice Fortescue's mention of town (*villa*) as an integral part of the hundred, just as the hundred was an integral part of the shire. It is important also to note the well-known fact that the town (*villata*) was throughout the mediæval

[1] This signification appears to have survived in Scotland; as, in Scott's Redgauntlet, Letter XI., where Darsie Latimer expresses a doubt whether he ought to go to Redgauntet's "town" in disguise, the context showing that it is only his house that is meant.

[2] The German city of the middle ages was created not like the English borough, by giving higher powers to an already existing organism, but by cutting out a section of territory and bestowing upon it public functions of a municipal character. See articles by v. Below, *Historiche Zeitschrift*, 1888.

period the unit of representation[1] — and that not as a mere representative district, but as a body politic; for at this period representation was never of artificial divisions, but of corporate bodies. This is clearly a political or constitutional function. Such phrases as "by the consent of the saide Township," and "with the consent of the hole Towne," in the sales of church property mentioned above, imply organized and collective action — an assembly or "town meeting" of some sort.

That the township lacked the higher judicial powers is admitted by Bishop Stubbs, who says (p. 90): "their assemblies are rather gemots or meetings, than proper courts; for any contentious proceedings amongst men so closely connected and so few in number, must have been carried immediately to the hundred court." That the township did have a gemot or meeting, is proved by the mention of a *tunscipesmot* in a charter of Richard I., and that this meeting had certain definite powers of self-government, apart from its function as a unit of representation, is shown, for example, by the Costomary of Tettenhall Regis (English Gilds, p. 432), a body of regulations or "bye-laws" made by the tenants of the manor at their Leet or Law-day. This Costomary is a complete body of laws for the government of the community; and in the body of these laws the word "town" is twice used to designate the manor in its public relations.

"Art. 19. No man shall make yates or gapes in the common field, upon the corne or grasse of his neighbors, but by the consent of [the] comonty; and if he do, he shall give to the lord 2s., and to the comonty of the towne 2s."

"Art. 21. No man of oure towne shall enter upon the stubble of any other towne while the corne is upon the ground, except it is upon his own land, and by the good will of all his neighbors, under payne of iijs. to the lord."

In the passages just cited we have "town" used as equivalent to "manor," just as in those previously cited, it was used as equivalent to "parish." The manor was the feudalized township, that is, the township converted into a fief, as the parish was the township regarded as an ecclesiastical organization. And just as, in the sixteenth century, the parish, or ecclesiastical organization, superseded the township; so in the middle ages the manorial or feudal organization superseded, or at any rate obscured, the township, the original municipal division. This process of feudalization, or converting a free township into a seignorial estate, began very early in the Anglo-Saxon period. Indeed, even on the assumption that England was colonized by free peasants, organizing in free townships, we must at the same time admit the probability of a considerable proportion of seignorial townships, or manorial estates, side by side with the free communities, and intermixed with them. And whatever may have been the original status, it is certain that long before the Norman conquest,

[1] *Per quatuor legaliores homines de qualibet villata* (Assize of Clarendon, 1.)

there remained very few self-governing townships, composed of free peasants.[1] I do not consider the king's, eorl's and man's *tun* of Aethelbirht's Laws, to have been feudalized townships, at least not always or necessarily; they appear rather to have been farmsteads. But fifty years later the charters of the *Codex Diplomaticus* afford ample evidence of towns which were the private property of the King or powerful noblemen, the peasants or *ceorls* being their tenants and fast becoming their serfs, as I showed in my paper of last year.

The two-fold process here described, of converting the free townships into manorial estates, and the free peasants into servile tenants upon those estates, was consummated in the complete feudalization of England which followed the Norman conquest. Nevertheless the town organization was not obliterated, but only obscured. We have seen that it continued to serve as a basis for representation, and we have frequent mention of the town, *villa*, as the equivalent of the manor. The word *villa* is used about a dozen times Domesday Book, at least three of these times as equivalent to manor. E. g. (i. f. 199 b.) "Wluuin the thane held this manor. In the same town Reginald holds half a hide of Alberic." [So ii., 31 and 31b.] The Exeter Domesday and the Ely Inquest, documents which appear to be the rough draft from which the great record was made up, often use the word *villa* where the Exchequer Domesday says *manerium*, "manor."[1] But the two words are not used as equivalent, but rather as describing the same territorial area from different points of view. There might have been two manors in the same vill, or lands in the vill while were independent of the manor. Indeed it would naturally be the case that the manor would often vary from the town in respect to metes and bounds, while the parish or ecclesiastical organization would, like the town itself, be an unchangeable district. The manor, being a piece of private property, would be subject to the laws of private property, and would be divided, added to or diminished, through the processes of purchase, sale, inheritance and inter-marriage. So greatly have these processes changed the boundaries of manors, that it is stated that in East Kent there is only one manor co-extensive with the parish. (Academy, No. 167). We find, however, instances of this identification of manor and town as late as the sixteenth and seventeenth centuries. In the "Certificates of Church Goods in Suffolk," in the reign of Edward VI., is mentioned: "Mr. Sakford, lorde and patron of the Towne," evidently lord of the manor. In the time of the Civil Wars (1648), the Memoirs of Col. Hutchinson speak of Cromwell having "a design, by insinuating himself into Colonel Saunders, to flatter him into the sale of a town of his called Ireton." (ii., 137.)

When the town was feudalized and became a manor, its *gemot*, or meeting, seems to have become that branch of the manorial court known

[1] For examples, see paper upon "Village communities and serfdom in England."

[2] The Ely Inquest rests upon the evidence, among others, of *sex villani uniuscujusque villae.*

as the Court Leet. The Court Leet, found also in the Hundred and the Borough, was, as is shown by the example given above, an assembly for the passing of bye-laws and administering the affairs of the town, the precise prototype of the New England town meeting. It also had a limited police jurisdiction, held to be derived from that of the Sheriff's Tourn or Leet of the Hundred. It was not a necessary part of the feudal or manorial organization, but, "was created by special grants from the crown to certain lords of manor in order that they might administer justice to their tenants at home." Quoted by Elton, "Custom and Tenant Right (1882)," p. 89. It was a thoroughly democratic institution, "being regarded as the court of the residents within the district; not of the tenants of the manor;" and "so far is this carried that a stranger passing by may be compelled to serve on the leet jury. The fact of his being found within the district is deemed sufficient evidence." Digby, Int. to the Law of Real Property, p. 45. The Leet, as a popular court, is also found in Iceland during the middle ages. The antiquity and primitive character of this court is attested by Elton, who says (on Copyholds, p. 240) it "is in all probability older than the manorial system itself:" and by Ritson, "The Jurisdiction of the Court Leet," who says (p. 6): "The Leet is the most ancient court in the land." This court elected the constable, and, in some boroughs, the mayor (id. p. x.).

It is not surprising, considering their early and almost universal conversion into manorial estates, that we find so few traces of free townships in England. From their absence, Mr. Seebohm has attempted to establish the thesis that the townships of England were regularly manorial estates, and the peasants serfs, from the earliest settlement of the Anglo-Saxons in the country. "The evidence of the earliest Saxon and Jutish laws" he says, "thus leaves us with a strong presumption, if not actual certainty, that the Saxon *ham* or *tun* was the estate of a lord, and not of a free village community." (English Village Communities, p. 175.) I attempted in my paper, read a year ago to show that, with regard to the peasantry, his evidence was inadequate, and that we have good ground for affirming the existence of a large class of free peasants in the earliest time. My object in the present paper has been to continue the argument, and show that there is good reason to believe that there were free townships as well as a free peasantry in the earliest English period. In arguing, however, that the township was a body politic, and "the unit of the constitutional machinery." I would not be understood to claim for it original and self-existent autonomy, even in the period of the earliest evolution of institutions. Assuming that the Germanic peoples passed from a community of occupation based upon kinship to one based upon territorial relations; it was the Hundred, not the township, that formed the earliest territorial community or *markgenossenschaft*. The township, or *Dorfschaft*, is shown by Thudichum to have been formed out of the hundred by a process of sub-division; and in this process the German district thus formed succeeded to no integral share of the powers of the original organization, but stood to it as

ward to a city. The English district corresponding to it, on the other hand, became an autonomous community, with substantial and important, if not original powers.

The English town has therefore no counterpart in any other Germanic nation; for in all the other Germanic nations the unit of the constitutional machinery is the Hundred, a district too large to allow of this immediate and detailed exercise of local self-government which we find in the New England towns, and, as has been made to appear, in those of England. Much less has it any counterpart in the Celtic and Slavonic nations, which never advanced unassisted to the territorial principle of government; nor in the Romance nations, whose government, derived from that of the later Roman empire, was wholly summary and authoritative. On the other hand, the ancient Greeks and Italians — the only branches of the Aryan race which possessed an equally strong political sense with the Germanic — developed a territorial system which has a strong analogy with the English.

The City (*civitas*, *πολις*), is the political type of the Greeks and Italians, as the Town is of the English: and while the two institutions diverged greatly in their development, they were essentially identical in their origin and structure. The Greeks, Italians and Germans alike passed from the social stage of institutions, based upon personal relations, to the political, based upon territory, at a very early period. In all of these we find the territory divided up into autonomous districts, small enough in extent to permit the direct participation of all the citizens in the work of government. The Greek City was thus identical with the German Hundred. But the development of all the Germanic nations, except the English, was arrested by the creation of great centralized monarchies. Even in England the more perfectly organized district, the Town, was shortly checked in its development by the establishment of the manorial system; and even where a higher municipal type was developed, in the boroughs, it was sporadic and thus incomplete.

The Greeks and Italians, on the other hand, concentrated and intensified their political life by what is known as *Synoikismos*,— the establishment in the middle of the territory of each city, of an *oppidum* or *urbs*, a place of collective residence, surrounded by walls, in which were erected their public buildings, and where they transacted all public and private business. This higher organization was applied to *all* cities, not merely to some here and there, like the English boroughs. These nations became urban in their life, while the English remained rural. But, in becoming urban, in building a city surrounded with walls for residence, trade, worship and social life, they did not shift the basis of their political organization. The city continued, as it had always done, to comprise the rural districts as well as the walled town; citizenship indeed was based upon ownership of land outside the walls equally with residence or property within the walls: the distinction between *rus* and *urbs* was purely social, in no sense political. Now the *oppidum*, inclosed within its walls, is very much the same thing as

the *tun*, enclosed with a hedge — a higher development upon the same general lines. But there was one point of contrast of vital moment. The Greek or Italian city, even if of no greater extent and population than an English town, was a sovereign state; the English town, however large and populous, was only a municipality, a part of a larger organism.

The word that is used in the Latin documents of the middle ages as meaning "town" is *villa* (or *villata*) — a word that has had a curious and interesting history. In classical Latin it means a country house — whether a farm-house, *villa rustica*, or a gentleman's country seat, *villa urbana*, in which sense it corresponds precisely to our modern word, *villa*. From meaning "house" it came by a not long or difficult transition, to mean the "estate" surrounding the house; and in this sense we find the word used in the later Roman empire. This was a period of great landed properties; but these properties, at least in Gaul, were not "plantations," *latifundia*, or vast and indefinite stretches of land, like the Dalrymple farm. Each great property was made up of a number of *villas*, not necessarily contiguous, each of these *villas* being a compact, organized estate of a moderate size. The small peasants' estates had for the most part disappeared, and Gaul at this epoch may be described as divided up into seignorial or domanial estates, corresponding roughly to the *communes*, or smallest territorial divisions of modern France. These *villas* agreed in many important particulars with the English manors, being perhaps of about the same extent, and being ruled autocratically by their owners.

The important fact to be noted here is the change in the significance of the word *villa*. From meaning a gentleman's country house, it has come to mean the estate depending upon that house; that is to say, it has acquired the meaning of a territorial district. And although the district thus designated in Gaul is a seignorial estate, it is easy, when the word has once become associated with the idea of an area of land, to extend its use to other districts of similar extent and grade. Thus we find it applied even on the continent to the *Dorfschaft* or village mark,[1] and in England it is used to designate the township, whether free or seignorial. But that it is the township that is thus designated, as a territorial area, and not the seignorial estate into which the township has been converted, is proved by the important fact, already noticed, that the manor and the township (*villa*) are not always identical. No argument, therefore, for the originally servile character of the English *tun* can be drawn from the fact that *tun* is in Latin *villa;* for although in Gaul a *villa* was a seignorial estate, in England it was not the estate as such, but an area of land, often identical with the manor, but often containing two or more manors, or parts of manors, or isolated pieces of land.

Thus the word *villa*, having acquired the signification of a territorial area, was used in England as the Latin equivalent of *Tunscip*. And as *villa*

[1] Van der Kindere, *Notice sur l'origine des magistrats communaux.*

was "*town*" — whether free or seignorial — so the cognate word *villanus* was "townsman" — whether free or serf. It is used regularly as the Latin equivalent of "ceorl," the free peasant of the early period, the semi-servile peasant of the later period, and the *villein* of the feudal period. When the ceorls lost their ownership of land, and their free status, their name sinking from the designation of a free yeoman to the opprobrious term "churl;" so the equivalent word *villanus* sank likewise, until it too, from meaning a free townsman, a member of the body politic, came to mean one who lived upon the land of another man, who was his master, paying for it by obligatory labor. And as "ceorl" has sank to "churl," so the honorable term *villanus* has sank to the opprobrious term *villain*.

A few words in conclusion, upon a subject more obscure in itself, and of more purely antiquarian interest — the connection of *tithing* and *township*. The word *tithing* is used as equivalent to *township* in some of the southern counties of England at the present day,[1] and it has been a matter of some controversy what is the origin of this territorial signification of the word, and how far back in time it dates. For the discussion of this question I will refer to Prof. H. B. Adams' excellent paper in the Johns Hopkins Studies, Vol. I, No. 4. It is admitted that there is no positive evidence of any but the numerical use of the word *tithing* in Anglo-Saxon times, as designating a group of ten men — *tenmanne tale* (Edv. Conf. xx) — formed for the purpose of enforcing mutual responsibility, as the fundamental principle of the system of the time for the preservation of the peace. The groups would seem at this period to have been strictly organized by tens. But after the Norman Conquest, under the more efficient *frithborg* system then established, the numerical value appears to have become a secondary consideration, and we very soon find a tendency towards localizing the term. Of course the original tithings were in a sense local; that is, each voluntary group of ten must have been composed of neighbors, and each township would naturally contain a number of such groups, none of them extending their membership beyond the bounds of the township. But in the thirteenth century (1284) we find, in the *Liber Niger* of the Monastery of Peterborough, a list of townships, each of which consists of a fixed number of tithings, varying, no doubt, according to the population. Of the town of Bartona we read (p. 109): *tota villata debet presentari per sex capitales decennarios* — the *capitales decennarii* being the "headboroughs" or "tithingmen." Other towns range from six of these officers to one, and we see the local character of the office in the fact that that they are the regular representatives of the town in the great court of the Hundred: (p. 113) *omnes libere tenentes et omnes capitales decennarii de predictis villis et foedis a tempore cujus non extat memoria, sc. ante tempus Willemi Regis Conquistoris . . . solebant venire bis in anno ad duas magnas curias que appellantur Turna vicecomitis, etc.* Now, it is evident that in the small townships which had only one tithing, it would be very natural and easy to identify the two terms, and

[1] Stubbs. Const. Hist. i, 85.

thus localize the word *tithing*. Of this we see further evidence in the Cartulary of the monastery of Gloucester. Vol. iii, No. 966, gives the items in the view of frankpledge in the Court Leet of the manor; among which we read: *de hiis qui sunt xii annorum, et non sunt in toethinga*. From this passage the tithing might appear to be a purely numerical group: but in No. 1,011 we read: *sunt tenentes in tethynga de Chirchesdona*, where the word tithing seems to have a clearly local value.

The passage from the numerical to the territorial signification is an easy one, and is illustrated by these passages. We see from the passage above cited that all boys of twelve were enrolled, not merely heads of families, as is sometimes assumed; and the same rule was observed in Anglo-Saxon times, as is shown by the law of Canute (ii., 20 *ofer xii wintra*). With the growth and order of good government, so large a number of groups as this came to be no longer necessary. Two centuries after the Conquest, we find small towns containing but one tithing, and the largest only six, which may perhaps have been divisions of its territory into wards or districts. From this condition of things the purely territorial meaning of the word in some parts of the country may easily have been derived.

My object in this paper has been partly to trace the origin and powers of the English town; partly to help to an understanding of its connection with the New England town. New England being colonized at just about the time that the parish organization was superseding that of the town in the mother country, it would seem, as I have already said, that the colonists, breaking away from the English ecclesiastical system, held to the town organization, making the parish purely secondary. The powers of the New England towns do not differ very widely from those of the English towns. We find, for example, in Russhemer, the "Implyments" of the money obtained by the sale of church goods to have been enumerated as follows:

towards the reparacioning of our churche - - - -	xl s.
ffurther to makyng of a pulpett & a lectern - - - -	xxiij s. iiij d.
also to the makying of a grett chest with locks - - -	iij s. iiij d.
Item to the pore peple of the parysshe - - - - -	xx s.
Also to the mendyng of the high weyes - - - -	xxiij s. iiij d."

East Anglier. July, 1887.

In other cases we find: "for ssyendyng fforthe of v Souldeors to the Kyngs Majesties warrs;" "in the wallyng of their marssh, in costs & chargs upon the havyn, And upon ther bulwerks of Gunnys. powder, & shotte for the defense & safegard of the town." : "to mainteyne a ffree scoole," etc.

These examples are taken from what I suppose to be small country villages, the prototypes of the New England towns. It may reasonably be supposed, however, that the boroughs, or higher class of towns, would give the example for the larger powers exercised by our more independent towns; and I find in the East Anglian (1886–8) a series of extracts from the records of the important town of Ipswich, as late as the time of the Com-

monwealth, which remind one, by the variety and minuteness of their functions, of those of the New England towns: for example, the hiring of preachers and teachers, as well as the care of roads, the supervision of markets, etc. The "Great Court" of Ipswich, consisting of "all the freemen, Portmen, Aldermen and Bailiffs," corresponds very closely to the New England town-meeting. The most characteristic feature of the New England town-meeting is, however, wanting — the requirement that the magistrates assume no control of the assembly, but retire into a private station, as it were, for the occasion; the meeting electing its own chairman, and exercising authority as a self-governing democracy. In most popular assemblies the magistrates are the presiding officers: in the English "vestry" or parish-meeting it is the parson, in the Great Court of Ipswich, one of the bailiffs. This feature of the New England town meeting, which, with others, it shares with the higher parliamentary bodies, may perhaps be claimed as another instance of the survival in America of usages or institutions which have become extinct in the mother country. Gneist says (p. 202): "The meeting was summoned by the churchwardens; the chair was regularly taken by the parson, as the landlord of the vestry, and the first member of the ecclesiastical parish, as a matter of courtesy, but a positive right of presiding could be established neither by precedent nor by analogy. In analogy with the tax-granting commoners, the meeting was rather regarded as its own master, in respect to the appointment of a chairman, as well as in respect to its adjournment. The voting was conducted with equal rights for each individual, after the manner of the old courts leet, the parliamentary elections, and the parliamentary resolutions. The mode of giving the vote was, as a rule, by show of hands, but in difficult and doubtful cases, by a poll."

My thesis, that the English towns of the middle ages were an integral part of the constitutional machinery, and not mere corporations, like the corresponding bodies of Germany, I have attempted to prove by showing: first, their territorial character, as conterminous areas of land, embracing the entire country; secondly, their practice of self-government in local concerns, and their organic relation to the larger representative bodies. We have seen that in the sixteenth century, at which time the parish became the organ of local self-government, the terms *town* and *parish* were used indifferently for the same institutions; and that in the seventeenth century, when the American colonies were planted, the colonists carried with them a *town-system* essentially the same as the *parish-system* which continued in England. The analogy with German institutions is misleading. The English people developed the institution of the "town" upon their own soil; and it is to be compared, not with the imperfect creation of the continental Germans, from which it was perhaps derived, but with the matured institution of New England, to which it gave birth.

REPTILIA AND BATRACHIA OF WISCONSIN.

By Prof. W. K. HIGLEY.

This list is not presented without a realization of the fact that some species may be omitted. If, however, any such are found, it is believed that they will be rare and local species, perhaps found in the outskirts of the state, which is subject to the migration of species from other regions. The Mississippi river forms an excellent pathway for the introduction of some strangers to our Reptilian and Batrachian fauna.

It is hoped that the present list will not only be found complete, but that the key may be found adequate for the determination of species.

The key is one that has been used in class work under the direction of the writer, and has been found sufficient for all local purposes. It has been arranged for the species of this state *only*, and, it is believed, in such a way that no new species will be reported that cannot be brought under its range, for in its preparation all extralimital species, liable to be found here, were included.

The classification followed is to a great extent that used by my friend, Dr. W. H. Smith, in the Herpetology of the State Survey of Ohio.[1] Dr. Jordan's "Manual of the Vertebrates" and the list reported by Dr. Hoy in our State Geology, have also been of great service, the former in the identification of species, and the latter both as a check list, and also as a source of information as to the range of some species outside the districts from which the writer had identified specimens.

REPTILIA.

Animals having an epidermal covering in form of scales or plates which in one division become united with the bony skeleton forming an outside shield or shell; cold blood and an incomplete circulation; the heart three chambered in our species: the lungs large, consisting of but few cells; no metamorphosis; the respiration pulmonary throughout life.

KEY TO THE ORDERS OF REPTILES.

1. Epidermal covering united with the skeleton forming a shell which more or less completely covers the body; no teeth; anal opening roundish or longitudinal..... *Testudinata.*

[1] State Survey of Ohio, Vol. IV, Zoology and Botany.

I. Epidermal covering not united with the skeleton, scales or rarely plates; anal opening transverse; teeth present.
   a. Body much elongated, serpentiform; limbs wanting; mouth dilatable; eyelids none; no urinary bladder..... *Ophidia.*
   b. Body elongated; feet usually present; mouth not dilatable; eyelids usually present; urinary bladder present. ..... *Lacertilla.*

ORDER TESTUDINATA, TURTLES.

Body more or less perfectly inclosed in a bony or leathery shell-like case, plastron and carapace; epidermal plates usually quadrilateral in outline; animal variable in form, but generally short, thick-set or flattened; neck generally long allowing of considerable freedom of the head; the head, limbs and sometimes the tail may be completely withdrawn into the area of the shell; the bones of the skull finally became united by complete ossification; tongue thick; jaws forming a horny beak; food bolted; no teeth.

KEY TO FAMILIES OF TESTUDINATA.

I. Plastron very flat and divided into distinct parts which are so hinged, by two transverse divisions, as to form, with the carapace, a very perfect box; carapace very convex and deep; animal thickset; toes only slightly webbed; jaws not hooked or but slightly so; food mostly carnivorous..... *Cistudinidæ.*

II. Longitudinal section of the shell somewhat ovate in outline, caused by the position of the vital organs which are placed far forward, the carapace is thus higher anteriorly than posteriorly; plastron small and cruciform consisting of 12 plates; head and neck very muscular; jaws powerful and more or less strongly hooked; tail muscular with a ridge of horny obtuse or acute processes above, the longest often measuring more than an inch, and with two or more rows of scales underneath; very voracious and extremely fierce; mostly carnivorous and aquatic..... *Chelydeidæ.*

III. Longitudinal section of the shell ovate or oval, usually deepest near the center; edge of carapace obovate or oblong in outline, broadest posteriorly; plastron with 12 plates covering the entire under surface of the body, the anterior lobe sometimes hinged to the posterior; jaws not hooked, obtuse; carnivorous ..... *Emydidæ*

IV. Body placed far back in the shell, causing an obovoid longitudinal section; carapace osseous, margins more or less reflexed underneath; plastron composed of a variable number of plates, seven, nine or eleven, and hinged, allowing the animal to more or less perfectly close its shell; head pointed; odor strong..... *Cinosternidæ.*

V. Shell orbicular or sometimes with an oval or oblong outline; covered by a leathery, more or less flexible skin; shell never fully ossified, and in some species with the ribs projecting; head long and conical..... *Tryonychidæ.*

FAMILY CISTUDINIDÆ, BOX TURTLES.

Represented by one genus and two species. Mostly carnivorous, and to some extent decidedly carrion eaters.

CISTUDO, Fleming.

C. clausa, Gmelin. Common Box Turtle.

Varies greatly in color; back ground always dark (black, brownish or drab) with yellowish spots or blotches; shell nearly oblong in outline; plastron sometimes truncate; anterior lobe the shorter, generally found in high but moist woods. Very rare. Two specimens have been reported from Walworth county.[1] Length of carapace about six inches; height about three inches.

C. ornata, Agassiz. Northern Box Turtle.

In many respects very similar to the last. Shell nearly orbicular and without keel. "Grant county; rare." Hoy: Walworth county.

FAMILY CHELYDRIDÆ, SNAPPING TURTLES.

Aquatic species of great strength, living in ponds and muddy streams. Represented by two genera and two species.

KEY TO THE GENERA OF CHELYDRIDÆ.

a. Head covered with skin; tail with two rows of scales underneath..... *Chelydra.*
b. Head covered with plates; tail provided with many scales underneath in several rows..... ..... *Macrochelys.*

CHELYDRA, Schweigger.

C. serpentina, L. Common Snapping Turtle.

Very common and well known.

MACROCHELYS, Gray.

M. lacertina, Schw. Mississippi or Loggerhead Snapper.

This ferocious turtle is occasionally found in the Mississippi river as far north as the mouth of the Wisconsin. Hoy.

FAMILY EMYDIDÆ, POND TURTLE.

The members of this family are generally very mild when approached, simply relying on the rapidity of their motions or by plunging into the water to effect their escape. Some forms (*Crysemys*), however, when taken in the hand, will snap quite savagely at the fingers.

Represented by five genera and six species.

KEY TO THE GENERA OF EMYDIDÆ.

a. Crapace more or less depressed or flattened; toes webbed; plastron broad and flattened, yellowish:
(a). Plastron movable on the carapace and divided, the anterior division being smaller and movable by a transverse hinge; plastron with irregular black spots..... .. *Emys.*
(b). "Upper jaw notched in front; shell not keeled in adult" (Jordan); toes strongly webbed; plastron immovable; carapace with outer plates *usually* marked with red..... ..... *Chrysemys.*

[1] Since writing the above, the author has identified specimens of *C. clausa* from Milwaukee, Pine Lake, La Crosse and Green Bay.

(c). "Upper jaw not notched in front; carapace more or less strongly keeled or tuberculated." (Jordan); toes strongly webbed; plastron immovable; lower jaw with a spoon-shaped dilatation..... *Graptemys*.

b. Web small; shell elongated, nearly oblong in form; plastron without hinge; carapace deep; black with or without orange or yellow spots which are round or oblong; upper jaw notched slightly; plastron light yellow with black irregular spots..... *Nanemys*.

EMYS, Brogniart.

E. meleagris, Shaw. Blanding's Box Tortoise.

Carapace dark colored with irregular yellow spots that are seldom absent. Terrestrial but generally found near water, to which they rapidly retreat if approached. Excellent swimmers. Common.

CHRYSEMYS, Gray.

C. marginata, Holb. Lady Turtle. Western Painted Turtle.

Neck, tail and legs striped with red; the plates of carapace variously marked with red or yellow. A beautiful species. Very common.

C. oregonensis, Holb. Plain Tortoise.

A form without red markings of *marginata*, is found occasionally in the western part of our state.

GRAPTEMYS, Agassiz.

G. geographica, Le Sueur. Map Turtle.

Streaked and reticulated with various shades of yellow upon a brownish back ground; neck and limbs quite gaily colored; carapace deeply notched posteriorly; aquatic; not common.

Probably this species is the most bold and active of this family. L. 9 inches.

G. Le Sueurii, Gray. Le Sueur's Map Turtle.

The characters distinguishing this from the preceding are not numerous but prominent. The colors are less striking in general, but the yellow markings are more intense; back ground grayer; each vertebral plate has a dark colored posterior which overlaps the succeeding plate; plastron clouded with brown or black; length of carapace 5-6 inches. Quite common in southern half of the state.

NANEMYS, Agassiz.

N. guttatus, Ag. Speckled Tortoise.

Carapace black with yellow spots scattered here and there; plastron with more or less black. But two specimens are known to me to have been found in this state. These were from Walworth county.[1]

FAMILY CINOSTERNIDÆ. CINOSTERNOID TURTLE.

Represented by one genus and species.

[1] Additional localities, reported after the above was written, Beloit, Madison, Eau Claire and other places, indicating that it is rare but generally distributed throughout the southern part of the state.

AROMOCHELYS, Gray.

A. odoratus, Latreille. Musk Tortoise.

Jaws strong; color dark with or without spots; head large with yellow spots on the side; a strong musky odor is always present; plastron black and yellow; marking more or less obscured by the adhering mud. Rare. Found in southern part of the state. I have found it in Walworth county.

FAMILY TRIONYCHIDÆ. SOFT-SHELLED TURTLES.

Represented by two genera and two species.

a. "Nostria terminal, crescent shaped" (Jordan); carapace with tubercles on the anterior margins..... *Aspidonectes.*

b. "Nostrals rather under the top of snout" (Jordan); no tubercles on the anterior margin of carapace. .....*Amyda.*

ASPIDONECTES, Wagler.

A. spinifer, Le Sueur. Soft-shelled Turtle.

The habits of this animal are such that they do not need hard shells for protection. Their color is not far from that of the mud of the streams in which they live. I have repeatedly passed by groups of them while dredging, without seeing them. My observations lead me to believe that they are generally found in groups. They are found in the southern and western parts of the state. Though not often met I believe them to be quite common.

AMYDA, Schweigger.

A. mutica, Le Sueur. Leathery Turtle.

Upper parts brownish; beneath, whitish without spots; anterior margin of carapace without spines or tubercles. This last character distinguishes it from the last. Found in the western half of the state and more common than the last, and with the same habits, though my observations lead me to believe that it is not so voracious.

ORDER LACETILIA. LIZARDS.

Body elongated or lacertiloid in form and covered by scales; limbs four (or two) or none; top of head covered with plates; tail quite long and generally brittle;[1] jaws with teeth, but they are not in sockets.

KEY TO THE FAMILIES OF LIZZARDS.

1. Tongue squamose, thick, fleshy, emarginate at the free extremity—free anteriorly and not protrusible; eyes medium size; eyelids scaly; scales quincuncially arranged; head subtriangular cephalic plates present and regular..... *Scincidæ.*

[1] This serves as an excellent means of defense. It is very natural for one to catch the tail of a lizzard sooner than any other part because of its swiftness. The tail being very brittle it is no sooner touched than it breaks off. Jordan says this is owing "to a thin, unossified, transverse septum, which traverses each vertebra." I have had them lose their tails also when confined to close quarters.

2. Tongue palpillose, fleshy, emarginate and more or less free anteriorly; cephalic plates more scale-like or irregular; scales carinalted; head short; eyelids scaly..... ..... *Iguanidæ.*
3. Limbs not visible but present in a rudimentary state beneath the skin; ear distinct; lateral fold present; serpentine in form; cephalic plates quite large; abdominal region covered with square plates; tongue bifid..... *Arnguidæ.*

FAMILY SCINCIDÆ. THE SKINKS.

Represented by one genus and two species.

EUMECES, Wiegmann.

E. quinquelineatus, L. Blue-tailed Skink.

Color bluish-black with five yellow stripes, the dorsal stripe divides at the head sending a branch to each side of the vertical plate; beneath light blue; throat whitish; tail deep blue; the stripe disappears to a great extent with age: L. 7–8 inches; tail 4–5. Walworth County; rare.

I believe that this species will be found more common in all the southern counties, though it has not been reported to my knowledge. Its range is very extensive. It may be found to the best advantage in May, in dampish, unfrequented woods under bark.

E. septentrionalis, Baird. Northern Skink.

Olive with four darker stripes; two narrow lateral lines of white and black. Walworth County, "Not uncommon as far north as Lake Winnebago."[1] Hoy.

FAMILY IGUANIDÆ. THE IGUANAS.

Represented by one genus and one species.

SCELOPORNS, Wiegmann.

S. undulatus, Harlan. The Brown Swift.

Color brownish with irregular bands of black; greenish blue laterally; abdomen yellowish with dark spots; toes whitish: throat with skin more or less folded; L. 6 inches; rare. A few specimens have been reported from this state. I have not met it myself.

FAMILY ANGUIDÆ. THE GLASS SNAKES.

Represented by one genus and one species.

OPHISANRUS, Daudin.

O. ventralis, Daudin. The Glass Snake.

Colór dark and yellowish with black streaks; quite common.

"In early days they were not uncommon near Kenosha. They occur in in the western part of the state as far north as La Crosse." Hoy.

[1] Since writing the above, the writer has examined several specimens from the western part of the state.

ORDER OPHIDIA. SNAKES.

Body covered with imbricated scales; beneath with a single row of band-like scales (gastrosteges) as far back as the anus. Represented in this state by two families.

KEY TO THE FAMILIES OF SNAKES.

1. Both jaws with ungrooved conical teeth; tail tapering, plates underneath (Urosteges) in pairs, without a rattle; no pit in front of the eyes; head more or less oblong, and usually tapering gradually into the neck..... *Colubridæ.*
2. No solid teeth, or but few in the upper jaw; jaw provided with grooved erectile poison fangs; tail provided with a rattle; Urosteges undivided, at least anteriorly; a pit in front of each eye; scales carinated; head separable from the body and more or less triangular..... *Crotalidæ.*

FAMILY CROTALIDÆ. THE CROTALID SNAKES.

Represented by two genera and two species. To this family belong some of the most deadly poison snakes.

KEY TO GENERA OF CROTALIDÆ.

a. Head covered with small scales, tail with large rattle..... *Crotalus.*
b. Head covered with nine large plates; tail with rather small rattle.. *Crotalophorus.*

CROTALUS, L.

C. durissus, L. Yellow Rattle Snake. Banded Rattle Snake.

Sulphur brown with darker in blotches or arranged, more or less regularly, in bands; head very triangular and ugly; dorsal scales in 23-25 rows; G. 170–180; U. 23–28; L. 3 to 5 ft. In rocky places; rare. Formerly this species was very common, but it is seldom met now. It may be found in the rocky bluffs of our larger rivers. Very poisonous.

CROTALOPHORUS, L.

C. tergeminus., Holb. Massassauga or Prairie Rattlesnake.

Color brownish, "Spots of dark brown margined with black, and exterior to this a still lighter circle; vertebral blotches, 34 in number, almost quadrate, notched in front and behind, and extending from neck to tail; 2 to 3 series of lateral blotches on each side varying from circular to oblong" (Smith). There are other series of lighter lines, but the above will be sufficient to determine the species. Dorsal scales 25 rows; G. 140–150; U. 25–30; L. 2–3 ft.; not rare; in grassy marshes throughout the state. Poisonous.

Variety Kirtlandii, Holb.

Much darker and more uniform, with darker blotches above. Walworth county; rare. W. H. Smith in the State Survey of Ohio says,*— "The

* Vol IV, p. 674.

specimens of *C. tergeminus* which I have seen from Wisconsin, have a broader head and the transition from the head to neck is more abrupt than in Illinois or Ohio specimens."

It is safe to assume, then, that all snakes that have a triangular head, that may be met in this state, are to be avoided.

FAMILY COLUBRIDÆ. THE COLUBRINE SNAKES.

Represented by eleven genera, twenty species and several varieties.

The following Key for the determination of the genera is a modification of that used by Jordan, Smith, and others.

Dorsal scales carinated, a.
Dorsal scales smooth, i.
a. Post-abdominal scutella entire, b.
a. Post-abdominal scutella bifid, c.
b. Dorsal rows of scales not exceeding 23 ... *Entœnia.*
b. Dorsal rows of scales exceeding 25 ... *Pityophis.*
c. Loral and anteorbital plates, both present, d.
c. Lorals absent ... *Storeria.*
d. Dorsal rows of scales, 19 or more, e.
e. Cephalic plates typical, f.
e. Cephalic plates not typical, large, h.
f. Post-orbitals three, rarely two; ante-obitals usually one; dorsal rows of scales, 23–29 ... *Tropidonotus.*
f. Post-orbitals two; dorsal rows of scales, 19-21 ... *Regina.*
h. Muzzle projecting and recurved ... *Heterodon.*
h. Muzzle not projecting ... *Coluber.*
i. Ante-orbital plates both present, j.
j. Post-abdominal scutella entire or bifid; dorsal rows of scales 25 ... *Ophibolus.*
j. Post-abdominal scutella bifid; dorsal rows of scales not exceeding 21, k.
k. With yellow ring around the neck ... *Diadophis.*
k. Without a ring around the neck, l.
l. Dorsal scales in 15 rows ... *Liopeltis.*
l. Dorsal scales in 17 or more rows ... *Bascanion.*

EUTÆNIA, B. & G.

Our most common snakes; terrestrial; ground color dark; one vertebral and two lateral stripes; gastrosteges 140–170; urosteges 50–120; dorsal rows of scales 19.

It is believed that the following Key will enable one to trace any species or form commonly found, though great variations in the markings exist.

(a) Lateral stripe on the third and fourth rows of scales: body slender; tail nearly one-third of total length, (b).
(a) Lateral stripe on second and third rows of scales; body stouter; dorsal band on one and two half rows of scales; tail one-fourth of total length; G. 132-170; U. 55-80 ... *Sirtalis.*
(a) Scales rough; stripes all narrow; lateral not usually over a scale in width, placed on part of two rows; six or seven series of brownish or blackish spots; outer row of scales often very broad ... *Radix.*

(b) Occipital plates with a yellow spot; upper labials eight; dorsal band on one and two half rows of scales: lateral stripe on third and fourth rows: G. 165–180; U. less than 110. ..... *Proxima.*

(b) Orbital plates yellowish; upper labials seven on each side; dorsal line on about one row of scales terminating at posterior margin of the occipital plate: G. 175–180; U. 115 or more. ..... *Saurita.*

E. sirtalis, L. Striped or Garter Snake.

Ground color, blackish; dorsal band yellow; lateral band yellowish; abdomen greenish; occipital plate sometimes with two yellow spots; upper labials 7 or 8; offensive when handled; L. 2–2¼ feet; tail about 6 inches; abundant.

Variety dorsalis, B. & G.

Dorsal stripes broad and marginal on each side with black in one row of scales; lateral stripe with a row of dark spots above; common.

Variety parietalis, B. & G.

Dorsal stripe medium; brick red spots in lateral bands; not rare.

Variety ——— with dorsal stripe absent, yet with all the characters of the typical form present. Walworth county; rare.

Dr. W. H. Smith suggests for this variety the name *melanota.*

E. radix, B. & G. Hoy's Garter Snake.

General color above black, with three very narrow yellow lines; head short; L. 2–2½ feet; G. 150–165; U. 53–85. Not rare.

E. saurita, L. Swift Garter or Ribbon Snake.

Slender; tail very long and slender, pointed; color dark brown; stripes extending the whole length, but indistinct in the tail and sometimes becoming obsolete near the end; dorsal and upper edge of lateral lines with blackish or brownish margins; under parts greenish; L. 2½–3 feet; tail 9 inches; southern part of the state in damp woods; not rare.

Variety faireyi, B. & G. Fairie's Garter Snake.

Occipital plates with two yellow spots; lateral line margined on both sides by black; same range as the last; not common.

E. proxima, Say. Say's Garter Snake.

Ground color black; beneath whitish to olivaceous, dorsal band yellow or darker; lateral greenish or whitish; beneath lateral strip lighter than above; L. under 3 feet; tail under 9 inches; southern half of the state; not rare.

PITYOPHIS, Holbrook.

P. sayii, Schl. Western Pine Snake.

"Whitish or reddish with many dark blotches and spots; dorsal scales usually 25 rows. G. 220–230; L. 40–70." Jordan.

"A large species; in early days it was common in the western part of the state; now rare." Hoy.

L. 4–11 feet; reported from northwestern counties; rare; large specimens very rare.

Storeria. B. & G.

KEY TO THE SPECIES OF STORERIA.

(a) *Scales* 15 *rows;* belly red; G. 120–123; U. 40–50; Anteorbitals two; upper labials 5 or 6; lower 6 or 7.... .... *occipito-maculata.*

(b) *Scales* 17 *rows;* under parts greenish or nearly white; G. 120–140; U. 46–60; upper and lower labial plates 7..... ..... *dekayi.*

S. occipito-maculata, Storer. Red-bellied Snake.

General color above grayish or brownish, with (usually) or without a dorsal band margined by darker spots; L. 9–15 inches; tail about 2 inches; common througout the state.

S. dekayi, Holb. Little Brown Snake.

General color grayish brown; dorsal stripe lighter margined by dotted lines; a black line from the occipital plate to the angle of the mouth; one or two black spots below the eyes; L. 12 inches or less; tail about 2; southern part of the state; not rare.

Tropidonotus, Kuhl.

Our species have eight upper and ten lower labial plates; these are large and prominent; aquatic habits; food mostly fish and other water animals.

KEY TO THE SPECIES OF TROPIDONOTUS.

(a) *Dorsal scales* 27 *rows; outer row smooth;* above with quadrangular dark spots about 48 or 50 in number, and reaching to the end of the tail .... *rhombifer.*

(b) *Dorsal scales* 23 (variety with 25); above with three series of dark blotches, the dorsal row larger than the others; abdomen irregularly marked with yellow and brown ..... *sipedon.*

(c) *Dorsal scales* 23; *under parts* copper colored; head large, triangular; general color above, reddish black without spots or blotches.....*erythrogaster.**

T. rhombifer, Hallowell. Holbrook's Water Snake. Water Adder.

General color, brown; L. 2½–3 ft.; G. 140–145; U. 63–74; tail about 6 inches; unfrequented damp places; rare; Walworth county.

T. sipedon, L. Water Snake. Water Adder.

General color brownish; markings sometimes obscure in old specimens; young with markings very decided, but with some variations in their colors; body large; carnivorous, living almost entirely on fish; L. 3–4 ft.; tail 10–13 inches; G. 150–155; U. 65–80; southern counties; not common.

* *T. erythrogaster*, Shaw. Since this report was presented to the Academy, I have seen two specimens of this species; one from near Beloit, and the other from Lake Geneva. Rare.

REGINA, B. & G.

Habits aquatic or terrestrial; dorsal scales in 19 rows.

KEY TO THE SPECIES OF REGINA.

(a) Ante-orbitals two; upper labials, 7; lower, 8; beneath yellow; three black dorsal and a yellow lateral band ..... *leberis.*

(b) Ante-orbitals one: *beneath brick red,* with dark near the exterior of the scutellæ; upper labials, 6; lower, 7..... *Kirtlandii.*

(c) Ante-orbitals two; beneath, yellowish; upper labials, 7; lower, 8; above, brownish; dorsal line lighter and bordered with black; lateral line yellow, bordered with dark, in first second and third rows ..... *Grahamii.*

R. leberis, L. Yellow-bellied or Leather Snake.

Above, brownish; lateral band on the first and second rows; L. 2–2½ ft.; tail 5–6 inches; G. 140–150; U. 65–80; not common.

R. kirtlandii, Kennicott. Little Red Snake.

Above brownish or purplish brown with irregular blotches in four rows, the outer being the larger; L. about 1 ft.; tail about 3 inches; G. 120–140; U. 55–65; Walworth county, and probably throughout southern counties; rare.

R. Grahamii, B. & G. Graham's Snake.

Scales strongly carinated; lateral line broad; L. 1½–2 ft.; tail 3–4½ inches; G. 160–165; U. 57; mostly in western countries; not rare.

HETERODON, Beauvois.

Body quite thick set and can be dilated at will of the animal by inhalation of air; hissing very peculiar and characteristic, similar in sound to the rattle of the rattlesnakes; head triangular. These snakes have a strong resemblance to venomous species, when angered or disturbed, flattening their bodies and head and hissing in a very threatening manner. Odor very marked and unpleasant.

H. platyrhinus, Latreille. Hog-nose Snake. Blowing Viper. Spreading Adder.

Above brownish with 28–30 dark dorsal blotches varying from quadrate to circular; lateral blotches irregular; these blotches become rings on the tail; *vertical plate longer than broad;* beneath, slate color and varying on post-abdominal region from yellow to reddish; upper labials yellow; dorsal scales 25 rows (usually); G. 125–150; U. 45–50; L. 2½–3 feet; tail 7–8 inches; on sandy or dry localities as far north as Madison; not common.

Variety niger, Catesby. Black Viper.

Uniform black or brown above without spots; said to be more ferocious than the type but is harmless; about the same range as the last; rare.

H. simus, L. Hog-nosed Snake.

General color lighter and more yellow than the last species; about 32–35 dorsal blotches; *vertical plates broader than long;* interfrontal region with 4–8 small plates; dorsal scales 23–27 rows; L. 2⅕–3 feet; G. 130; U. 45–55; sandy localities throughout the state; not rare.

Coluber, L.

Body large; head elongated; ante-orbitals one; post-orbitals two; mouth deeply cleft; upper labials 8, lower 11.

KEY TO THE SPECIES OF COLUBER.

(a) Dorsal scales 25 rows; color above light brown with more or less quadrate, chocolate colored blotches in three rows, the dorsal two or three times larger than the lateral; head light brown or yellowish above..... *vulpinus.*

(b) Dorsal scales 27 (usually); color black and shiny; scales often margined with yellowish; head black above..... ..... *obsoletus.*

C. vulpinus, B. & G. Fox Snake.

Vertical plate broader than long; abdomen with colors in blotches; L. 5 feet; tail about 10 inches long, large at the base; prairies throughout the state; food, small vertebrates and insects; not rare.

C. *obsoletus*, Say. Pilot Snake or Racer.

Upper labials yellowish; beneath darker and more or less mottled with yellow, black and whitish; vertical plate longer than broad; dorsal scales 27 rows (usually); L. 4–6; tail 10–11 inches; G. 230–235; U. 80–85; found throughout the state in timbered districts, but is not common.

Feeds on squirrels, birds, bird's eggs, etc.; is somewhat arboreal in its habits. The larger forms are very rare.

Ophibolus, B. & G.

O. triangulus, Boie. Milk Snake.

Local names numerous and various. General color grayish with three series of black margined brown blotches, the dorsal row numbering about 50, and elliptical to oval in shape; lateral spots in two rows, varying in size; head with two blotches above; blotched beneath; dorsal scales in 21 rows; G. 200–210; U. 48–55; L. 3–4 ft.; tail 5–6 inches; varies greatly; habits carnivorous; common.

Diadophis, B. & G.

D. punctatus, L. Ring-necked Snake.

Bluish black (or darker) above, without spots; occipital region with yellow ring or spots; beneath orange or lighter, each plate generally having a dark spot; head depressed; dorsal scales 15 rows; G. 140–165; U. 35–58; L. 1½ ft.; tail about 3 inches, found under stones or bark of decaying trees; odor strong; not rare.

LIOPELTIS, Fitzinger.

L. vernalis, De Kay. Green or Grass Snake.

Body slender; head elongated; color above bright and uniform deep green; lighter or yellowish beneath; L. 1–1½ ft.; tail about 4½ inches; G. 129–140; U. 70–98.

A beautiful species, very lively in its movements; insectvorous. Common throughout the state in damp places, and may often be seen in the morning when there is dew on the grass.

BASCANION, B. & G.

B. constrictor, L. Blue Racer or Black Snake.

Varies in color; our form varies from azure blue to blue-black; beneath greenish; mouth deeply cleft; head elongated; dorsal scales smooth and usually in 17 rows (sometimes 19); L. 4–6½; G. 170–205; U. 80–115; southern part of the state; not common.

This form varies considerably from the Black Snake of the east in its color, which is often a very intense azure blue; especially immediately after moulting. Dr. W. H. Smith suggests that this form might well be made a variety with the very appropriate name of *cæruleus*.

BATRACHIA.

Body always without true scales and covered by a smooth skin; metamorphosis after birth and usually complete; respiration branchial in the young, and either pulmonary or both pulmonary and branchial in the adult; heart with two auricles and one ventrical; circulation incomplete.

KEY TO THE ORDERS OF BATRACHIA.

I. Body thick set and when adult without a tail; the posterior limbs much longer than the anterior and developed first in the metamorphosis; skin smooth, granular or warty; tongue free behind and can be protruded with great rapidity..... *Anura.*

II. Body elongated; the four limbs very widely separated, short and of nearly equal length; tail, persistent and usually long; tail compressed or terete; fore limbs developed first in the metamorphosis; motions more or less snakelike..... *Urodela.*

ORDER ANURA. TAILLESS AMPHIBIANS.

KEY TO THE FAMILIES OF ANURA.

1. Posterior toes webbed; anterior toes more or less webbed; upper maxillary and vomer-palatine teeth present; skin smooth, or essentially so; posterior limbs exceeding the length of the body and much longer than the anterior; tympanum distinct and prominent; fingers not dilatable; tongue emarginate at free extremity; live near water..... *Ranidæ.*

2. Toes more or less webbed; upper maxillary and vomer-palatine teeth present; tympanum distinct; fingers and toes with disks at their tips; skin more or less granulated; tongue usually simply notched at the free extremity; chiefly arboreal..... *Hylidæ.*
3. Toes webbed; posterior limbs hardly as long as the body; skin usually warty; tympanum small and not apparent; jaws without teeth; tongue entire at free extremity; terrestrial, nocturnal, and insectivorous.....*Bufonidæ*

FAMILY RANIDÆ. THE FROGS.

Represented by one genus and five species.

The following is a key to species of the genus:

RANA, L.

(a). Dorsal region with *large* and distinct irregular dark spots in usually two (rarely more and these scattered) rows upon a greenish or brownish background; beneath very white or yellowish; eyes prominent and usually with two dark blotches between them[1] ..... *halecina.*

(b). Dorsal region with or without *small* dark spots:

(1). Color green or brown; irregularly spotted (or speckled) on the legs and sides with dark which may reach to the dorsal region; beneath white to yellow; irides yellow..... *clamitans.*

(2). Reddish or greenish brown; a dark line passes through the tympanum and eye, often reaching to the nostrils; legs usually barred or blotched with dark above; tympanum small; beneath yellowish or whitish. *temporia, var. sylvatica.*

(3). Greenish brown with dark irregular spots which are conspicuous on the legs and sides; beneath yellowish, often mottled with dark brown; tympanum large; animal very large and muscular; pupils black; irides green ..... *Catesbyana*

R. halecina, Kalm. Leopard Frog.

L. 3 to 4 inches; posterior limb 6 inches; in wet places and especially in marshes and along streams; common.

R. clamitans, Daudin. Green or Spring Frog.

Thighs granulated posteriorly; L. 2-3 inches; posterior limb about 4 in.; anterior limb about 1½ in.: common along brooks and ponds; often in wet weather may be found wandering to some distance from any stream.

R. temporania, L. Var. sylvatica, Le Conte. Wood Frog.

L. 2 inches; posterior limb about 2½ in.; anterior limb about 1½; in damp woods among leaves; not rare.

R nigrescens, Ag. Black Frog.

Prof. Agassiz determined a specimen caught at Racine as the *Nigricans;* Rare." Hoy.

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[1] *R. palustris* has the dorsal spots usually square, in four rows with smaller spots scattered irregularly outside.

Having no description, and never having seen this form, I am unable to place it in the Key. Some of our authorities, however, consider it merely a form of *clamitans*.

R. palustris, Le Conte. Marsh or Tiger Frog.

This is quite common in Michigan, and may possibly be found in Wisconsin; L. 2–3 inches; posterior limb about 4; anterior limb about 1½.

FAMILY HYLIDÆ. TREE TOADS.

Represented by two genera and four species.

KEY TO THE GENERA OF TREE TOADS.

a. Toes nearly or quite distinct; fingers quite distinct; disks small; body slender; tongue emarginate behind..... *Chorophilus.*

b. Toes webbed; fingers more or less webbed; disks large; body often thick set; tongue, if at all only slightly emarginate behind..... *Hyla.*

CHOROPHILUS, Baird.

C. triseriatus, Wied. Little or Striped Tree Frog.

Color bluish ash or blackish; more or less striped; skin with granulations; no warts; toes with trace of web at the base; L. 1 to 1½ inches; posterior limb about twice as long as the anterior.

"*C. maculatus*, Ag. Spotted Tree Frog.

Found on Lake Superior." Hoy.

HYLA, Laurenti.

H. versicolor, Le Conte. Common Tree Toad.

"Patches of vomerine teeth slightly elevated; tongue slightly notched behind." W. H. Smith.

Color varying from green to brown with irregular spots; below dirty white to yellow, seldom spotted; common.

"*H. pickeringii*, Holb. Pickering's Tree Toad, abundant." Hoy.

"Patches of vomerine teeth not elevated; tongue truncate behind;" W. H. Smith. Reddish or yellowish brown; spots dark, rhomroidal; lines dark, and sometimes cuneiform in arrangement.

FAMILY BUFONIDÆ. THE TOADS.

Represented by one genus and one species.

BUFO. Laurenti.

B. lentiginosus, Shaw. Var. *Americana*, Le Conte. Common Toad.

Body warty and very rough when adult; color cinereous and brownish; speckled; below yellowish or dirty white; tympanum not very apparent; pupils black; very common.

ORDER URODELA. TAILED AMPHIBIANS.

KEY TO THE FAMILIES OF URODELA.

1. Gills persistent..... *Proteidæ.*
2. Gills caducous; gill slit closed in the adult..... *Salamandridæ.*

FAMILY PROTEIDÆ. THE MUD PUPPIES.

Represented by one genus and one species.

MENOBRANCHUS, Harlan.

M. lateralis, Say. Mud Puppy. Dog Fish. Water Dog.

Body cylindrical and smooth; general color brownish with spots of darker; a black lateral line is sometimes present; gills red and bushy, in three groups on each side; tail compressed; nocturnal and aquatic, living but a few moments on land; L. 1 to 2 ft.; common and carnivorous.

FAMILY SALAMANDRIDÆ. THE SALAMANDERS.

Represented by five genera and eleven species.

KEY TO THE GENERA OF SALAMANDRIDÆ.

a. Tongue fleshy, attached by the center, the lateral and anterior margins being free; costal grooves very distinct; vomero-palatine teeth transversely arranged; posterior toes, 5; color dark; skin smooth with numerous pores; tail compressed ..... *Amblystoma.*

b. Tongue attached by the anterior aud posterior edges, a small part of the lateral being free; costal grooves indistinct; vomero-palatine teeth longitudinal and divergent behind; posterior toes, 5; tail compressed from the base; colors bright. ..... *Notophthalmus.*

c. Tongue roundish, the anterior edge and center attached, the lateral and posterior free; vomerine teeth in two patches; posterior toes, 5; general color dark; tail tapering to tip..... *Plethodon.*

d. Tongue oval, attached by the anterior edge; *toes, four in front and behind;* costal grooves distinct; general color above brown; beneath white with black spots; tail, long, round at the base and then compressed ..... *Hemidactylium.*

e. Tongue attached by the center, the entire edge being free (boletoid) costal grooves distinct; vomerine teeth in a tranverse row; posterior toes, 5; color yellowish or red; tail long, tapering and compressed.... *Spelerpes.*

AMBLYSTOMA, Tschudi.

A. opacum, Gravenhurst. Blotched Salamander.

Color above dark with tranverse bluish gray bars or blotches; head with a triangular spot; below slaty; costal furrows or grooves, 11; no large pores on head. L. about three inches; tail about 1½ inch; rare. "Racine." Hoy.

A. punctatum, L. Large Spotted Salamander.

Black or nearly so with bright yellow spots arranged along each side on the dorsal furrow, which is quite distinct; skin with numerous pores which are enlarged and arranged in two patches on each side of the head; costal furrows or grooves, 11; L. 6 inches; tail, 2½ inches; southern part of the state; not common.

A. tigrinum, Green. The Great or Tiger Salamander.

Everywhere dark with yellow spots which are either round or irregular; costal furrows or grooves, 11; dorsal groove quite distinct; head depressed; L. 7 inches; tail 3 inches; common.

A. jeffersonianum, Green. The Granulated Salamander.

Variable; in general brownish or blackish with ashy spots, but "sometimes uniform plum" (Jordan); costal furrows 13; the furrows on the tail extending nearly to the tip; L. 3 to 4 inches; tail 1-2 in.; Walworth county; rare. Dr. Hoy reports them from Racine. I have reason to believe that they may also be found in the extreme northern part of the state.

Notophthalmus, Raf.

N. viridescens, Raf. Common Spotted Triton. Newt. Eft.

Color: olive to scarlet above, and orange to red underneath (variable); spots on sides, vermillion enclosed in a black ring and usually in a line; beneath with black dots; costal grooves about 14. *H. miniatus*, Raf. I believe to be the same species, and I have included its characters in the above description. I have seen the two forms at the same pond during the breeding season, and have also noted gradations in color between the two extremes. It seems to me highly probable that age has something to do with the darker color; L. 3-4 inches; tail 1-2; common in brooks and ponds.

Plethodon, Tschudi.

P. erythronotus, Green. Red Backed Salamander.

Dorsal stripe red, extending nearly the whole length of the animal; sides cinereous; head brown above; lower jaw whitish; costal grooves or furrows 16 to 19; caudal grooves 18–22; L. 3–4 inches; tail 1–2; southern Wisconsin; not rare.

Variety cinereous, Green.

Without the red dorsal stripe. This form may be met, and I have placed it here as a variety merely to aid in identification for it would seem from the investigations of our best authorities that the changes are simply those wrought by age.

Their food consists of snails, worms and insects.

P. glutinosus, Green. Gray Spotted or Viscid S.

Above glossy black with very small gray spots; lateral spots larger; costal furrows 14; spotted below; in moist places; color varying with age, there being fewer spots on old specimens; not common.

HEMIDACTYLIUM, Tschudi.

H. scutatum, Schlegel. Four-toed Salamander.

"Color above, brown, muzzle yellowish, limbs and tail orange brown; upper surface with black spots on each side scattered irregularly; beneath white with patchy black spots," Smith. Rare; "Racine." Hoy. Habits, Insectivorous.

SPELERPES, Rafinesque.

S. ruber, Daudin. Red Salamander. Red Triton.

Color above, intense red with small roundish black spots; color less marked beneath; head triangular; costal grooves 14-16; L. 5 inches; tail about 2; in damp and unfrequented swamps of southern half of state; not rare.

S. longicaudus. Green. Cave or Long Tailed S.

Yellow spotted with dark; below spotless, yellowish; head oval; costal furrows 13; L. 5 inches; tail 3–3½ inches; Walworth county; Racine," Hoy; rare.

S. bilineatus, Green. Stripe-backed Salamander.

Yellowish or darker with two (or three) longitudinal black lines; below yellowish and unspotted; costal grooves 14; L. 2–3 inches; tail 1½ inches; two or three specimens have been reported from southern Wisconsin, "Racine," Hoy; rare.

REFERENCE AND CHECK LIST OF THE REPTILIA AND BATRACHIA OF WISCONSIN.

REPTILIA.

LACERTILIA.

SCINCIDÆ.

Eumeces quinquelineatus, L. Blue-tailed Skink.
Eumeces septentrionalis, Baird. Northern Skink.

IGUANIDÆ.

Sceloporus undulatus, Harlan. Brown Swift.

ANGUIDÆ.

Ophiosaurus ventralis, Daudin. Glass Snake.

OPHIDIA.

CROTALIDÆ.

Crotalus durissus, L. Yellow Rattlesnake.
Crotalophorus tergeminus, Holb. Prairie Rattlesnake, or Massassauga.
Crotalophorus tergeminus. Var. kirtlandii, Holb. Massassauga.

COLUBRIDÆ.

Eutœnia sirtalis, L. Common Garter Snake.
Eutœnia sirtalis, Var. dorsalis, B & G.
Eutœnia sirtalis, Var. parietalis, B & G.
Eutœnia sirtalis, var. melanota, Smith.
Eutœnia radix, B. & G. Hoy's Garter Snake.
Eutœnia saurita. L. Swift Garter or Ribbon Snake.
Eutœnia saurita, Var. faireyi, B. & G.
Eutœnia proxima, Say. Say's Garter Snake.
Pityophis sayii, Schl. Western Pine Snake.
Storeria occipito-maculata, Storer. Red-bellied Snake.
Storeria dekayi, Holb. Little Brown Snake.
Tropidonotus rhombifer, Hallowell. Holbrook's Water Snake.

Tropidonotus sipedon, L. Water Snake. Water Adder.
Regina liberis, L. Yellow-bellied or Leather Snake.
Regina kirtlandii, Kenicott. Little Red Snake.
Regina grahamii, B. & G. Graham's Snake.
Heterodon platyrhinus, Latr. Blowing or Spreading Viper.
Heterodon platyrhinus, Var. niger, Catesby. Black Viper.
Heterodon simus, L. Hog-nosed Snake.
Coluber vulpinus, B. & G. Fox Snake.
Coluber obsoletus, Say. Pilot Snake or Racer.
Ophibolus triangulus, Boie. Milk Snake.
Diadophis punctatus, L. Ring-necked Snake.
Liopeltis vernalis, DeKay. Green or Grass Snake.
Bascanion constrictor, L. Blue Racer. Black Snake.

TESTUDINATA.

CISTUDINIDÆ.

Cistudo clausa, Gmelin. Common Box Turtle.
Cistudo ornata, Ag. Northern Box Turtle.

CHELYDRIDÆ.

Chelydra serpentina, L. Common Snapping Turtle.
Macrochelys lacertina, Schw. Mississippi or Loggerhead Snapper.

EMYDIDÆ.

Emys meleagris, Shaw. Blanding's Tortoise.
Chrysemys marginata, Holb. Lady Turtle.
Chrysemys oregonensis, Holb. Prairie Turtle.
Graptemys geographica, Le S. Map Turtle.
Graptemys lesueurii, Gray. Le Sueur's Map Turtle.
Nanemys guttatus, Ag. Spotted Turtle.

CINOSTERNIDÆ.

Aromochelys odoratus, Gray. Musk Turtle.

TRIONYCHIDÆ.

Aspidonectes spinifer, Le S. Soft-shelled Turtle.
Amyda mutica, Le S. Leathery Turtle.

BATRACHIA.

ANURA.

RANIDÆ.

Rana halecina, Kalm. Leopard Frog.
Rana clamitans, Merrew. Green or Spring Frog.
Rana temporaria, L. *Var. sylvatica*, Le C. Wood Frog.
Rana catesbyana, Shaw. Bull Frog.
Rana nigrescens, Ag. Black Frog.

HYLIDÆ.

Chorophilus triseriatus, Willd. Little Tree Frog.
Chorophilus maculatus, Ag. Spotted Tree Frog.
Hyla versicolor, Le C. Common Tree Toad.
Hyla pickeringii, Holb. Pickering's Tree Toad.

BUFONIDÆ.

Bufo lentiginosus, Shaw, *Var. Americanus*, Le C. Common Toad.

URODELA.

PROTEIDÆ.

Menobranchus lateralis, Say. Mud Puppy.

SALIMANDRIDÆ.

Amblystoma opacum, Gray. Blotched Salamander.
Amblystoma punctatum, L. Large Spotted Salamander.
Amblystoma tigrinum, Green. The Great Salamander.
Amblystoma jeffersonianum, Green. Granulated Salamander.
Notophthalmus viridescens, Raf. Spotted Triton.
Plethodon erythronotus, Green. Red-backed Salamander.
Plethodon erythronotus. Var. cinereus, Green. Ashy Salamander.
Plethodon glutinosus, Green. Spotted or Viscid Salamander.
Hemidactylum scutatum, Schlegel. Four-toed Salamander.
Spelerpes ruber, Daudin. Red Salmander.
Spelerpes longicaudus, Green. Cave or Long-tailed Salamander.
Spelerpes bilineatus, Green. Stripe-backed Salamander.

SUMMARY.

	Orders.	Familes.	Genera.	Species.	Varieties.
Reptilia	Lacertilia	3	3	4	.....
	Ophidia	2	13	22	6
	Testudinata	5	11	13	.....
Batrachia	Anura	3	4	8	1
	Urodela	2	6	12	1
	5	15	37	59	8

RAISED BEACHES OF LAKE MICHIGAN.

By FRANK LEVERETT.

There are around the head of Lake Michigan several raised beach lines and sea cliffs, the latter being eroded escarpments of the tall plains and moraines. These have been discussed at some length by Dr. Edmund Andrews, of Chicago, President of the Chicago Academy of Sciences, in a pamphlet entitled: "The North American Lakes Considered as Chronometers of Post Glacial Time." The portions of the raised beach lines and sea cliffs in Cook county, Illinois, have been referred to by Mr. Bannister of the Illinois Geological Survey, in his report on the geology of Cook county, Vol. III, p. 240–2. Neither of these gentlemen have given the distribution of the separate lines with sufficient detail to subserve our purpose, and slight inaccuracies of distribution occur in Dr. Andrews' map which accompanies his pamphlet. We, therefore, feel warranted in presenting here the distribution and connections of the beach lines without further reference to previous publications, since our description is based upon those facts only which we have obtained independently.

The beach lines vary in number at different points around the head of the lake, in places there being but one or two — but elsewhere, several, and in Lake county, Indiana, a large number. There seem, however, to be but three lines which are maintained distinctly and vigorously for any great distance. We shall describe these as the Upper, Middle and Lower raised beaches.

UPPER RAISED BEACH.

Between Waukegan and Winnetka, Illinois, the lake shore is now farther west than it was at the time of the formation of the upper raised beach, for the lake is undermining undulating till ridges which show no evidence of having been submerged for any long period. North from Waukegan raised beach lines are developed at intervals, but they have not been studied with sufficient thoroughness to warrant a description. We, therefore, begin our description at Winnetka, in northern Cook county. An ancient sea cliff passes in a southerly course from the lake bluff through the eastern part of this village. The cliff is about twenty feet in height, and is a prominent feature in the village. Its base is very nearly 60 feet above the present level of Lake Michigan.

Following the sea cliff south we find it soon changes to a beach line, and gravel and sand in forms quite similar to those of the present beach lines of

the lake are developed for a distance of six or seven miles through the south part of Tp. 42 N., R. XIII E., and the central part of Tp. 41 N., R. XIII E. The highest part of the beach line, or beach lines, for a series of ridges is developed, is about 60 feet, occasionally 61 feet above Lake Michigan. In the vicinity of the Chicago river, the elevation gradually decreases to the level of the river bank, which is about 40 feet above Lake Michigan. These gravel deposits of the beach line, or of succeeding beach lines which lap onto its eastern face, have an eastward extension on the north side of the river, so that when we cross the river to find the beach line on that side we must go nearly two miles up the stream to catch it. This protrusion of the sands and gravels on the north side of the stream indicates that at the time this beach was forming the transportation of sand and gravel was southward along the shore, and that the current from the Chicago river, which opened into the lake at the point represented by the position of the beach line on the south side of the river, carried the material lakeward which was brought down by the slow moving lake current from the north. This extension is not in the form of a delta built up at the debouchure of the river into the lake — but lies wholly on the north side of the river valley. Moreover, to make it still more evident that it was the lake and not the river which contributed the great bulk of the beach deposit which skirts its north bank, we find that the river valley above the point where it entered the old lake has very little assorted material, such as would accumulate above a delta. The beach appears on the south side of the river in the south part of Sec. 19, Tp. 41, R. XIII E. It has here a very different aspect from that immediately across the river, being a low sea cliff, 6—15 feet in height, with occasional deposits of beach gravels and sands along its front. The terrace or sea cliff made by the lake, is crossed by the Wisconsin division of the Chicago and Northwestern railway, at Norwood Park. The profile of this road shows that the base of the sea cliff has an elevation of 45 feet, and the top an elevation of sixty feet above Lake Michigan.

At the point where the Chicago, Milwaukee & St. Paul railway crosses the cliff, in Sec. 32, Tp. 40, R. XIII E., the base has an elevation of 42 feet and the top 66 feet. The Omaha division of the Chicago & Northwestern railway crosses it at Oak Park, with an elevation of 38 feet at the base and 49 feet at the top of the cliff, and a mile further south the Wisconsin Central railroad crosses a beach deposit with an elevation of 41 feet at the base and 49 feet at the top.

The sea cliff phase extends only to Oak Park, a village on the east bank of the Des Plains river. The sea cliff passes through the east part of the village to the vicinity of the Chicago & Northwestern railway, where beach gravels conceal it, and we find here an extension of the beach gravel down the east side the Des Plains river, similar to that extension down the north side of the Chicago river. The gravel extends south from Oak Park, in the form of a ridge, or bar, 20 to 40 rods in width and 10 feet or more in height, for about two miles to the south part of Secs. 13 and 14, Tp. 39

R. XII E., terminating in a club-like expansion which rises to an elevation of about 55 feet above Lake Michigan, and nearly 20 feet above the plain which lies east of the Des Plains river, immediately south from its terminus. This bar or spit shows evidence, where opened, of having been built up from the east, by successive deposits shingled on its eastern slope — which dip with the slope. An excavation at Haas's gravel pit which extends from the east side of the bar west part of the center — shows beds dipping at various angles, but all toward the east — some of the beds increase in thickness as they descend, but the lower bed, which is mainly sand, increases in thickness toward the deeper portion of the ridge. It appears to be a sand bar upon which the beach deposits were built. The following section was obtained at the south-side of this gravel pit, which shows the section of that particular place only, for I am informed by Mr. Haas that the material of the same bed varies greatly in coarseness within the space of a few feet, but the dip of the beds is uniformly toward the east.

1. A brown-stained gravel at the surface extending down the slope. Depth 18—30 inches.

2. Fine gravel (unstained) 24 inches at top, increasing to 48 inches near base.

3. Sand beginning with scarcely any thickness at the top, but increasing to a thickness of 36 inches at the base of the excavation.

4. A bed of fine gravel increasing like No. "3" from 0—48 inches in thickness.

5. Fine gravel nearly four feet in thickness, which passes upward from near the east side of the excavation assuming a nearly horizontal position beneath the crest of the ridge.

6. Sand at the bottom of the excavation becoming thicker toward the higher part of the ridge. Depth 6—36 inches.

Molluscan shells thought to be Unios, and also smaller shells have been found in No. "6," but none of these were at hand at the time of my visit. Mr. Haas afterwards sent an oyster shell which was imbedded in No. "6," and near it was the tooth of a mammoth. If the oyster shell has not been artificially introduced it suggests much as to a salt water lake. It is possible that the shells thought by Mr. Haas to be Unios, were salt water mollusks. We learned of no other instance of the occurrence of molluscan remains along this upper beach.

Passing now to the west side of the Des Plains river we find about a mile above the southern end of the bar just described a low sea cliff or lake margin bearing in a curved course through Sec. 14, across the north side of Sec. 22, and then northwest into Sec. 16, Tp. 39, R. XII E. This is so low a beach that it scarcely attracts notice, being in places but 2—4 feet in height, but it has the continuity and horizontality of base that marks fossil lake shores.

A tributary of Salt Creek has removed the traces of the old shore west from Sec. 15. The beach comes to the swale which the stream follows.

Passing south about a mile we find the beach well defined in the northwest part of Sec. 28, of this township on the south side of Salt Creek. It is here a beach ridge composed of sand and gravel, and rises 10—12 feet above the border of the plain on the east. The beach line is 30—40 rods wide, and extends nearly one mile south from Salt Creek when the gravel disappears, and a sea cliff marks the continuation of the shore. The bank ridge is excavated about 40 rods from the north end in a similar way to that at Haas's pit; the excavation being from the east side of the beach west nearly to the outer slope. The excavation is 12—14 feet deep in the deepest part, and reveals a series of beds dipping slightly toward the east. The upper 5—6 feet is a brown-stained gravel. The lower portion is a fine gravel with sandy portions almost free from gravel. These sandy portions are not so calcareous as glacial sands. A slight effervescence was obtained in but one or two tests, out of a dozen or more. The gravel is made up of worn pebbles comprising nearly every class found in the drift of the vicinity. There is not such a predominance of limestone pebbles as in the kaves of the neighboring moraines. The nature of the gravel is very similar in Haas's gravel pit to that in the one just described.

A sea cliff passes south from the beach ridge just described, through La Grange. At the point where it is crossed by the C., B. & Q. Ry. its base is 46 and its top 64 feet above Lake Michigan. This cliff continues in a southeasterly course from La Grange to the west border of the Des Plaines river valley, having a height of 10—15 feet throughout the greater part of the course. It swings down the river and becomes a part of its bluff — from a point almost directly west from the village of Summit, near the corners of Secs. 10, 11, 14 and 15, Tp. 38, R. XII E.

Before continuing our discription of the distribution of the upper beach it will be necessary to say a word respecting the outlets of Lake Michigan at that time — since the beach lines are open opposite these outlets. There were two channels of discharge into the Des Plaines valley. The most northerly one had its western border, as stated above, about two miles west of Summit, and its eastern border was about three miles south from Summit, where the river enters the Valparaiso moraine. Between these points the water from the lake entered the channel now occupied by the Des Plaines river.

Another avenue of discharge into this valley was through what is known as "the sag," a low belt of marshy land about one-half mile in width, which passes almost centrally through Tp. 37 N., R. XII E., from east to west, and opens into the Des Plaines valley in Sec. 14, Tp. 37, R. XI E., at Say Bridge Station. Between these two outlets is a prominent portion of the Valparaiso moraine whose base shows evidence on all sides that it was washed by the waters of the lake, the rise from the plain on the east being nearly as abrupt as the bluff of the Des Plaines river on the west or the border of the sag on the south. The sea cliff which was formed around this moraine is flanked occasionally by gravel and sand deposits similar to those found farther north along the sea cliff which was cut in the plain.

South of the sag a sea cliff was formed along the foot of the Valparaiso moraine for about 15 miles southeast from the Des Plaines valley, the sag itself lying near the foot of the moraine for 10 miles or more. The Wabash railroad rises onto the moraine from the sag, whose elevation, as shown by its profile, is but 16 feet above Lake Michigan. The gravel flanking the high land each side of the sag indicates that a depth of 40—50 feet of water passed through it at the time of the formation of the upper beach lines.

The plain in Tp. 36 N., R. XIII E., which lies between the sag and the moraine, rises toward the moraine quite rapidly, its border next the moraine being 50 feet above Lake Michigan at the point where the C., R. I. and P. Ry. passes from the plain to the moraine. The sea cliff here rises 28 feet above the plain or 78 feet above Lake Michigan. It is not probable, however, that the water stood as high as the top of the cliff. There is evidence along the border of the moraine, a short distance east, that it was some five feet or more in depth — for sand and gravel deposits flank the moraine to about this elevation above the level of the plain.

In the northwest part of Sec. 25, Tp. 36 N., R. XIII E., a beach line leaves the border of the moraine, and from this point southeast to the state line near Dyer, Indiana, it lies one to two miles north. The Illinois Central railroad crosses it about one mile north of Homewood. The top of the ridge is 65 feet above Lake Michigan (as shown in the profile of this railroad). The beach deposits cover a width of nearly a mile where crossed by this railroad, and their north border is but 41 feet above Lake Michigan. The highest portion of the ridge is mainly sand, and evidently was drifted by the wind so that its crest is now several feet above the water level at the time of the formation of the beach.

At the crossing of the Chicago and Eastern Illinois Railroad near Glenwood, the crest of the ridge is 55 feet above Lake Michigan. The ridge maintains about the same elevation to Dyer, Indiana. A sea cliff flanked by beach gravels is developed near the state line.

Before taking up the description of this beach in Indiana we will note the effect produced by the lake upon "Blue island," a till ridge running north from Blue Island village, some five or six miles. It is evident that this till ridge was an island in the old lake, for its border is very abrupt like a sea cliff and its surface is billowy. Furthermore flanking nearly the whole of the western face — there are beach deposits — whose base is 35—45 feet above Lake Michigan. Toward the north end of the ridge the sand has drifted into dunes, a few of which attain an elevation of 80 feet above Lake Michigan, but the beach gravels were nowhere observed to have an elevation to exceed 55 feet above the lake. From the north end of the ridge a bar composed of both sand and gravel extends out across the plain in a W. S. W. direction for more than a mile. The plain is about 45 feet above Lake Michigan, and the bar rises in plains to an elevation of 15 feet above this plain. This was evidently formed in the lee of the ridge and is

an indication that the waters flowed west past the north end of Blue island, at the time when the bar was formed.

The upper beach in Indiana presents a very different aspect except at the immediate border of the two states from what it has in Illinois, for it is composed mainly of sand, and the sand has drifted into prominent dunes and ridges which have frequently an elevation of 25 feet or more above the plains which lie south of them, and still higher above those on their north face. The elevation of the plains which lie immediately south of the saud ridges seldom exceeds 60 feet above Lake Michigan. It is evident, therefore, that the level of the lake was not more than 60 feet at the time of the formation of this beach, though its dunes have sometimes an elevation of 80 feet above Lake Michigan.

From Dyer, a sea cliff flanked by beach gravels passes nearly due east, changing within two miles to a ridge of dunes. This ridge of dunes passes through Schereville and extends east of this village about two miles when it quite suddenly terminates on a till plain in the east part of Sec. 12, Tp. 35 north, range IX, west. The sand here apparently has drifted in a continuous ridge a mile or more beyond the old lake border, for passing northwest to the vicinity of Griffith, a distance of a mile or more, we find the lake border marked by another line of dunes or rather a belt comprising several more or less continuous lines of dunes trending W. S. W., E. N. E. in the same direction as the course of the Joliet division of the Michigan Central railroad from Griffith to Lake — and thence along the main line of the Michigan Central railroad for about five miles farther east. The belt is 1 and 1½ miles in width and lies almost entirely on the south side of these railroad lines. Near Liverpool this belt is joined by the line of dunes which represents the middle raised beach, and from this village eastward the two branches are closely associated. Near the crossing of the Baltimore and Ohio and Michigan Central railroads, a sudden deflection in the direction of the dune ridges occurs. The whole belt comprising here four main ridges and several smaller ones suddenly swerves from an E. N. E. to a nearly due north course — and passes north to the Calumet marsh, at the border of which all the ridges suddenly terminate. North of this marsh the lower beach ridges, or at least ridges which are quite continuous with those farther west that are evidently later than the upper and middle beaches, occupy the interval between the present beach of the lake and the till tracts which lie south of the system of raised beaches. We consequently find no indications on the north side of Calumet river, nor indeed in the portion of Indiana east from there that these beaches remain, for the sands of the lower beach conceal everything. In Michigan, however, we find traces of the earlier beaches, some of which have been mentioned in the preceding chapter. The till ridge which lies east of New Buffalo, has gravel in indistinct ridges at intervals on its western slope — the highest observed deposits being about 60 feet above Lake Michigan.

North of Galvin river in Secs. 36 and 25, Tp. 7 S. R. XXI W., is a beach

line running from the bluffs of the Galvin river valley, north to the lake bluff. Its elevation at the lake bluff is about 55 feet, by aneroid determination, above the present lake level. This probably represents the Upper beach.

At several points between these "clay banks" in Sec. 30, Tp. 7 S., R. XX W., and Sawyer in Sec. 2, of the same township, the gravels on the river slope of the till ridge, which passes from the clay banks northward are in the forms of beach lines. They occur at an elevation as great as the track of the Chicago and Western Michigan railroad, which is 55–60 feet at several points where comparisons could be made. One of the best developed fragments of a beach line may be seen 100 rods or more west of the depot at Sawyer, where it is crossed by a wagon road. No beach lines were observed north from Sawyer, which will be included with the Upper beach deposits, but occasionally the slopes of till ridges were coated slightly by gravel at elevations about the same as those of the Upper beach — *i. e.*, — 55 feet or more above Lake Michigan.

The lake bluffs north from St. Joseph were examined with reference to finding the elevation to which the gravels occur, both in eroded dunes and above till bluffs, but nowhere were any deposits found at a height exceeding 35 feet above the lake. Quite frequently eroded dunes exposed gravel to an elevation of 20—35 feet, but this is probably to be classed with the gravels of the middle and lower beaches.

THE MIDDLE BEACH.

We find it necessary to explain the general surface features of a tract north of the Chicago river before attempting to give the distribution of the beach lines which border it. There is a till plain lying east of the portion of the upper beach that lies north of this river. Its western border is 30 feet or more above the level of Lake Michigan. This till plain has a width of two to four miles, and descends toward the east to an elevation of but 10—15 feet above the lake. East of this till plain there is a prominent beach line rising to an elevation of 30—35 feet above Lake Michigan. The plain therefore appears to be bordered by two beach lines, the one on the west being 40 feet more or less above the level of the lake, while that on the east is 30–35 feet. Taking up now the distribution of these beach lines we can best describe the western one as lying along the eastern face of the portion of the upper beach north of Chicago river, differing from it only in elevation, and in having a more easterly extension down the north side of Chicago river. The eastern beach line leaves the lake bluff about two miles north of Evanston and passes nearly due south for some seven miles to Rose Hill cemetery. At the cemetery it makes an abrupt turn to a course slightly south of west and extends to Bowmanville in Sec. 12, Tp. 40 N., R. XIII E., where it drops down quite suddenly near the bank of the Chicago river. It does not reappear on the opposite side of the river. The interval between the eastern end of this ridge and the western terminus of the spur-

like prolongation of the western beach line down the north side of the river is fully 1½ miles. This inward curving of the southern ends of the two beach lines diminishes the distance between the ridges one-half, but still leaves so wide a gap that the connection of the eastern ridge with the series of raised beaches is not yet satisfactorily determined.

No good exposure was found in the western beach line, but the eastern has a diagonal exposure of its whole vertical section at the lake bluff. Portions of the plain which lies immediately west of this ridge are covered with peat, and we find that at the exposure along the lake a peat bed which lies near the surface just west of the ridge, passes under the ridge as shown in the following section and description.

Section near beach line beneath plain which borders it on the west:

1.	Soil and gray sand	12–15 inches
2.	Peat	2– 3 inches
3.	Gravelly sand	6–36 inches
4.	Yellow pebbly clay, very calcareous	11–12 feet

The clay No. "4" assumes a bluish cast near the bottom, just above the water's edge. Its upper surface is eroded, and No. "3" has filled up the old channels or irregularities in its surface. It is for this reason that it varies so much in depth. No "3" contains blocks of limestone 8–10 inches in diameter, but the majority of its pebbles are small.

As we go from this exposure through the exposed section of the beach, we find the sand which overlies the peat bed in the above section, increases in thickness as soon as the ridge is entered. When it attains a thickness of about five feet, a coarse gravel and cobble appears above the sand. This cobble-gravel is a thin bed at first, but increases to a thickness of 11—12 feet beneath the highest part of the beach ridge, and has here layers of sand interstratified with it. The bed of sand which lies beneath this gravel has a depth of some ten feet or more beneath the deepest portion of the ridge. It is underlain by a peat bed, the continuation of the peat which lies near the surface west of the ridge, as is shown in the above section. The peat bed has slight breaks in it beneath the beach ridge, but can be easily followed at a quite definite horizon entirely through it. It is 3—6 inches in thickness. It contains pieces of mangled wood beneath the higher portions of the ridge. Between this peat bed and the yellowish blue till which forms the base of the exposure, there is a gravelly sand 6—18 inches in depth. The till rises about 12 feet above the level of the lake. The elevation of the crest of the beach ridge is about 35 feet above Lake Michigan.

The peat bed is found along the lake shore east of this beach, near the surface, as it is west of the beach. The beach appears, therefore, to have been built upon a submerged land surface. There is probably significance in the fact that the peat only extends a few rods west from the beach ridge, but fringes it on this border for several miles. East of the beach the peat occupies a considerable portion of the interval between this and a

Lower beach which is described later, and it was observed beneath this lower ridge in the same situation as beneath the ridge just described. The writer has not been able thus far to satisfy his own mind with any theory explaining the burying of this peaty surface beneath these lake beaches If the beaches were composed entirely of sand, their material might have been drifted beyond the lake border and covered the adjacent lands, but there is here a heavy deposit of coarse gravel capping the beach, which certainly could not be drifted by the wind. It might seem easy to account for the phenomena by supposing that there have been oscillations of level with periods of emergence followed by periods of submergence, but we found no evidences of such oscillations elsewhere. The limitation of the peat to the immediate border of the beach also presents difficulties in forming an explanation under hypotheses which have thus far arisen. The writer has attempted to conceive a method by which a protective bar could have been built up into the form which this beach line presents, but has not been successful.

Continuing now the distribution and description of the Middle beach from the Chicago river southward, we find that the western Middle beach repeats the phenomena of the Upper beach in swinging down the north side of the Chicago river so that when we cross the river to find its continuation we must pass up stream some two miles. The Middle beach is well developed immediately north of Jefferson, in Sec. 9, Tp. 40, R. XIII E. It has here an elevation of 40 feet above Lake Michigan, and is therefore as elevated as the portion of the beach immediately opposite, and some 5—10 feet higher than the spur referred to above as extending eastward along the north side of the river.

This beach line has a course varying slightly to the east and west of south through Cragin's and Austin to the south part of Secs. 16 and 17, Tp. 39, R. XIII E., when it assumes a southeasterly course to the Des Plaines river, at Riverside. The following are the elevations of the crest of this beach at points crossed by railway lines: Jefferson, 40 feet; Cragin's, 38 feet; Austin, 38 feet; Wisconsin Central crossing (west side of Sec. 16, Tp. 39, R. XIII E.) 38 feet; Riverside, 40 feet.

This portion of the beach line between the Chicago and Des Plaines rivers seldom rises more than 6—7 feet above the plain, which borders it on the east, and but 2—3 feet above that on the west. It is a low beach, coated by beach gravels 1—2 feet in depth, with an occasional depth of 6—8 feet. This bench is a noticeable feature on the level plain, though its elevation is so slight, and its course is well shown by a narrow belt of timber, which follows it across the otherwise treeless prairie.

Between Riverside and Summit is the old outlet of Lake Michigan into the Des Plaines valley. At Summit there is a prominent beach line turning down the east bluff of the Des Plaines river, which traced eastward from this opening into the river valley, takes a more or less direct course toward the north end "Blue island till ridge," and keeping slightly north

of this till ridge, it swings around to its eastern side, and bearing away from its southern end, comes to the Calumet river near Riverdale. Its elevation at Summit is 40 feet; at Washington Heights, 41 feet; but at several points between these villages a survey made by the Chicago Drainage Commission, reports its elevation as 35 feet above Lake Michigan.

The best exposure of the structure of this portion of the beach is found at Summit. An extensive excavation is made near the curving portion of the beach, just as it is about to turn down the River Valley. The beds of gravel dip toward the north with a low angle (10—15°). There is but little sand with the gravel. For a short distance the excavation shows a depth of 20 feet of beach deposits, but in passing eastward the pebbly clay which underlies them rises perceptibly. The gravel is brown, stained to a depth of 3—4 feet from the surface. Below this depth it is unstained. It is but slightly calcareous, even in the finer sandy portions. The pebbles seldom exceed one inch in diameter. They are worn smooth like those along the present beach of the lake.

We are told that shells of Unios and of smaller mollusks, also fragments of wood, have been found at the base of the gravels, but none were at hand at the time of our visit. Portions of the beach east of Blue Island are quite sandy.

South from the Calumet river this beach has a wide break, for the lake discharged past the south end of Blue Island through the sag into the Des Plaines river valley. The outlet from Blue Island, west to the point where the sag narrows to pass through the Valparaiso moraine, has a width of no less than three miles. Its north border is well marked in the form of a sea cliff, on the north side of the sag, and on the south it washed the foot of the Valparaiso moraine. An island locally known as Lane's Island, lies in this outlet, and its borders are flanked by gravelly deposits, to an elevation of about 35 feet above Lake Michigan. This island apparently, was submerged at the time when the upper beach was formed, for its surface is very level and has a coating of sand. Similarly, a large tract of land west of Blue Island, which was not submerged at the time of the formation of the Middle beach, was covered by the lake at the epoch of the Upper beach.

We were interested in noting a boulder-strewn belt occupying the portion of the sag outlet, just east of the Valparaiso moraine. The boulders in places, number several thousand per acre, so that it is very difficult to till the soil. They are both Paleozoic and Archaen. They may, many of them, have been dropped by ice-floes at the time of the lake expansion, for the configuration of the channel west from here, is such as to impede a free discharge into the Des Plaines valley, but a portion of them probably, were dropped there by the glacier, at a much earlier period, for other gaps in the moraines, similar to the sag, where the lake had no outlet, often have a large number of bolders in them.

The lake at the epoch of the Middle beach, probably extended nearly as far

south as at the time of the Upper beach, for no beach lines were observed west of the Illinois Central railroad. East from this railway, however, a well-defined beach exists. It assumes sufficient prominence to be noticeable in Secs. 27 and 28, Tp. 36, R. XIV E., there being on these sections a low beach 10—15 feet high, a portion of which is a rocky escarpment, but the remainder is till across Thorn Creek, from the east end of this bench in Sec. 35 of the same township, a beach line of much strength is developed. It is 40—80 rods wide, and has dunes 20 feet or more in heighth. It has a nearly due east course for three miles in Illinois, passing through the village of Lansing. It continues into Indiana with the same course, lying along the north border of Cady marsh, to the eastern end of the marsh, thence it continues with a cousre slightly north of east to Liverpool, where it becomes associated with the Upper beach lines, and its further distribution is given in connection with those beaches. The Indiana portion of this beach west of its junction with the Upper beaches, is a single ridge of sand slightly pebbly in places. It drifts into dunes at several points, but none were observed whose height exceeds 40 feet above the plain at the base of the ridge. The ridge where not drifted into dunes, is some 15 feet above its immediate base, and has a width of 40 rods more or less. Its elevation at Lansing, Illinois, is 43 feet above Lake Michigan. No other elevations are at hand at time of writing.

Between this beach line and the Calumet river there is a plain underlain by pebbly clay, and having scarcely any coating of sand or gravel. The beach deposits seldom extend more than 80 rods north from the base of the ridge.

THE LOWER BEACH.

The most northerly point at which this beach has been identified is at Evanston, Illinois. It rises here nearly 25 feet above the lake, and has at its northern extremity a width of 30 rods or more. It passes through the eastern part of the city of Evanston, and its course from Evanston to Ravenswood is nearly south. From Ravenswood it bears slightly east of south, to Lincoln Park in the north part of Chicago, and passes through the western part of this park. In the early days of Chicago, the ridge was developed at intervals through the eastern part of the city, but all traces are now removed. In the southeast part of Chicago, and in Hyde Park, the beach has not been removed. Between Hyde Park and Englewood it is well developed, having an extreme elevation of 19 feet above the lake. From Englewood it passes south through Sec. 21, to the center of Sec. 28, Tp. 38 N., R. XIV E. South from here it is a low belt of land ½—⅝ mile in width, and rising scarcely 10 feet above Lake Michigan, which connects the low lands west of Chicago, and in the Stock Yards in the southwest part of Chicago, with the low land along Lake Michigan, near Lake Calumet.

South from this low belt there are two beaches, neither of which are the exact equivalents in height of the ridge we have just traced. The innermost of these beaches extends from the head of Lake Calumet, east of Pulman, northwest to the vicinity of South Lynn. In is a bench 4—6 feet

in height, capped by a slight deposit of beach gravels. Its elevation is but 12 feet above Lake Michigan, for two miles or more from Lake Calumet, but further west it is 15—20 feet. Low as it is, it marks a quite distinct change in the surface deposit. On its east side is a sand deposit, 1–18 feet in depth, but on the west there is a pebbly clay, except along beach lines already described.

A second beach lies about a mile west from the one just described. It is a bench or low sea cliff 10–12 feet in height along its southern part, but less in the northern part. It can be traced easily from the Calumet river, near Riverdale, north through Kensington, to the northwest corner of Sec. 15, Tp. 37 N., R. XIV W., where it merges into the plain which borders it. South of the Calumet river, in Riverdale, is a ridge of sand and gravel which is probably of the same age as the bench at Kensington. It has a course almost due southeast to the Indiana line, entering that state about 1½ miles south of Hammond.

An interesting problem arises as to the outlet of Lake Michigan at the time the lower beach was forming. There may have been a narrow outlet through the Calumet, from Riverdale to Blue Island, and thence through "the sag," into the Des Plaines valley. There may have been another from near Lake Calumet, just between the Englewood beach and the low benches above described, into the Chicago river near the Union Stock Yards, and thence west through a marshy tract called "Mud Lake," to the Des Plaines river. There may also have been an outlet via the Chicago river, through the city to "Mud Lake," and thence into the Des Plaines valley. There are no points along any of these low belts that exceed 16 feet above the present level of the lake, and those via. "Mud Lake" are in no case above 10 feet. Probably the whole region in and near Chicago, whose elevation is 15 feet or less above Lake Michigan, was covered with water at the time when this beach was forming. It is also probable that the outlet at the north end of Lake Michigan was opened during the period when the lower beach was forming, if it had not opened previous to that time.

We are indebted to Prof. Oliver Marcy, of Evanston, for a careful section of the beach at the lakeshore in Evanston, made in 1864, at which time there was a peculiarly good exposure. The section was exposed north of Heck Hall, at the border of the University campus:

1.	Surface soil, sandy	1½ feet
2.	Brown sand and fine gravel	2½ feet
3.	Coarser gravel, stratified	2½ feet
4.	Fine sand	2 feet
5.	Gravel containing bones of deer	1⅛ feet
6.	Fine sand containing oak logs	1½ feet
7.	Peat or carbanaceous earth, with a marl bed containing molluscan shells in the lower portion, or interstratified with the peat	1½ feet
8.	Gravel	3¼ feet
9.	Humus soil with cedar stump and logs	4–6 inches
10.	Yellow clay laminated and contorted—containing pockets of gravel	3½ feet
11.	Blue pebbly clay	2 feet
	Height of bluff	22 feet

Prof. Marcy has representatives of the above beds in their natural order, in a glass cylinder. He also has the organic remains referred to. The bone is a portion of the femur of a deer — (species not determined). The oak wood is well preserved but the cedar is mangled and slivered. Prof. Marcy also has specimens of mollusks collected from the marl beds associated with the peat in No. "7" of the above section. The following are specifically identified — 1. Planorbis campanulatus. 2. Planorbis pava. 3. Amnicola hinosa. 4. Pisidium dubium. 5. Cyclas sulrata.

Unios of various sizes occur, which are not specifically identfied. There are also other molluscan remains not included in the above species.

Mr. H. M. Bannister of the Illinois Geological Survey, mentions the fossils found in these beach lines in Vol. III, p. 242, of the Illinois Geological Reports. He states that there are found existing, species of Unio, Pisidium, Physa, Lymna, Planorbis, Volvata, Amnicola, Milantho and Ancylus.

A partial exposure at the point on the shore represented by Prof. Marcy's section abave given, was examined by the writer in 1887, and the following section obtained:

1.	Yellowish red (iron-stained) sand	3–5 feet
2.	Band of bog iron ore granular	4–6 inches
3.	Gravel with beds of sand included	5–7 feet
	The stratification is very irregular in thickness and assorting very imperfect) —	
4.	Coarse sand not calcareous	6–12 inches
5.	Calcareous loam	3 inches
6.	Yellow clay very calcareous with leaves embedded	3 inches
7.	Carbonaceous band not calcareous	2 inches
8.	Yellow calcareous clay similar to No. "6"	4–6 inches
9.	Band of carbonaceous material not calcareous	2 inches
10.	Brown sand with twigs and peaty material	8–10 inches
11.	Water bearing sand	

Talus obscures the lower portion of the bluff. Nos. "6" and "8" contain gasteropod shells.

Several exposures of Nos. "6—9" were noted along the lake bluff further north. They were found well developed at outcrops beyond, i. e., further northwest than the outcrops of beach deposits, which overlie them in the above section. Beneath them is a yellowish sand four feet or more in depth, and beneath the sand resting upon a pebbly clay is an occasional outcrop of humus soil, probably No. "9" of Prof. Marcy's section.

In a cut where the wagon road comes down to the lake shore, south of the Evanston waterworks, the peat beds pass back into the peaty soils of the low land west of this beach ridge. The connection of this peaty bed with that beneath the eastern ridge of the middle beach, has already been discussed in connection with that ridge.

The profile of Fullerton Avenue conduit in the north part of Chicago shows the depth of sand and gravel through the entire width of the deposit between the lake shore and Chicago river. The ridge portion of the lower

beach lies 1,400—2,100 feet from the lake shore, and the maximum depth of sand (25 feet), is about 1,700 feet from the lake. On the west border from 2,100—2,600 feet, the depth is about 17 feet, and from 2,600—6,000 feet it averages about 12 feet in depth. From the latter point westward the depth gradually decreases and the sand disappears 1,900 feet east from the Chicago river. From the inner border of the beach ridge, to the lake shore a distance of 1,400 feet, the deposits are about 18 feet in depth. At the water's edge the depth is but 10 feet. The profile continues out 1,100 feet beneath the lake and there is but three feet of sand and gravel at its terminus. The deposit throughout is mainly sand, but some gravel was encountered. Shells of Unios and other mollusks were imbedded at frequent intervals throughout nearly the whole width of the deposit. Beneath these beach deposits there is everywhere a pebbly blue-gray clay, and no difference could be detected in emerged and submerged portions. This pebbly clay is described in a previous chapter.

In Hyde Park, the lower beach contains much more gravel than is shown in the Fullerton Avenue profile. The width of the system of raised beaches between Hyde Park and Englewood, is fully one mile, and between these beaches and the present beach, the surface is covered with sand and gravel.

At Riverdale the beach deposits are scarcely four feet in depth, but at Dolton Junction they are eight feet and two miles east of Dolton, the depth along the west of the ridge is 12—15 feet, and at the state line it is reported to be about 24 feet. The whole surface from Lake Calumet south to the beach ridge just alluded to, is covered with sand, the depth of which in places is at least 18 feet. The whole interval in fact between the lower raised beach and the present lake shore is covered with sand, not only in Illinois, but also in Indiana and Michigan, as will appear on a subsequent page. Its separation from the present beach is merely a matter of elevation, apparently, consequent upon the gradual lowering of the level of the lake.

The beach which enters Indiana about 1½ miles south of Hammond, passes east through the villages of Hessville, Tolbston and Miller, lying 1—2 miles north of the Little Calumet, and about an equal distance south of the Grand Calumet river. East from Miller the beach is quite continuous as far as Michigan City, lying 1—2½ miles back from the present beach. East from Michigan City there are only fragmentary beach lines, the distribution of which will be given presently.

Between the beach just described and the present beach, there are in Lake County, Indiana, a series of lower beach lines separated by narrow swamps, which fill the whole interval between the lake and the beach, leaving no such broad level tracts as occur between the Middle and Lower beaches along the Little Calumet and between the Upper and Middle beaches along Caeby marsh. On the meridian of Hessville, there are not fewer than thirty of these lower beach lines. These beaches are more closely associated with the main Lower beach in Porter county, for the

interval between this beach and the lake is much narrower than in Lake county. These minor beach lines are but a few feet in height, and 6—10 rods in width. At their western ends they are lost in the sandy plain which borders Wolf Lake, Lake Calumet and other small lakes near the state line or the borders of Lake Michigan. It is probable that these beach lines have each in turn shut off portions of the lake lagoons, and thus made encroachments upon it. They were probably built up as bars, working their way westward along the coast, for the shore currents at the present day are carrying sand across the south end of the lake in a westerly course, and building up broad branches at the head of the lake.

By reference to the Illinois beach lines it will be seen that from Chicago south, the beach which formerly bore west of south to Englewood, has by gradual accretions along its eastern border, been built out several miles to the eastward. The shore currents on the west side of the lake are southward, and consequently they unite with the westerly currents on the south shore to build up a broad beach at the head of the lake; near the state line between Illinois and Indiana. Between the western ends of the low beaches in Lake county, Indiana, and the southern ends of the beach lines near Englewood, in Illinois, is a low sand-covered tract occupied by several small lakes, and nowhere rising to the height of the beach lines, much of it being scarcely five feet above the level of Lake Michigan. This was apparently an open bay at the time these bar-like beaches were forming, but has now become filled with sand, leaving Lake Calumet and other lakelets and ponds as remnants of its waters.

The shores of the lake at the present day are not stationary. In one place encroachments are made upon the bordering shores while in adjacent portions of the shore accretions and accumulation is going on. Thus from Waukegan to Evanston, Illinois, the bluffs are undermined and removed at a rapid rate, but from Evanston, south to the head of the lake, the accumulation along the beach is greater than the removal. On the opposite side of the lake from Langatuck, Michigan, to a point on the shore some ten miles southwest from Michigan City, Indiana, the removal is greater than the accumulation, but as is shown above, the accumulation exceeds the removal along the remainder of the south shore. The projecting points along the lake are undermined more rapidly than the heights, so that the lake tends toward a more regular outline by its erosive power, and as we have seen above the bay-like elongation at the head of the lake has been greatly reduced since the epoch of the main lower beach, so that the lake is also tending toward a smoother outline by its depositing power.

The lower beach in Indiana is composed mainly of sand — gravel being found only in its deeper portions. The sand has drifted into dunes throughout the entire length of the beach lines in this state — so that elevations taken along the crest of the main ridge do not show the height at which the lake stood during its formation. By aneroid determinations there is a range of more than 50 feet in the elevation of this crest, some portions be-

ing 80 feet or more, while other portions are but 30 feet above Lake Michigan. The depth of sand at the powder works near Miller, is 32 feet. Beneath the sand is gravel and sand in which are shells of mollusks called snail shells by the well-digger, who reported them. The elevation of the surface is probably not more than 50 feet above Lake Michigan.

Gravel has been encountered near the bottom of wells along the ridge in several instances; the writer has no means of computing accurately the elevation above Lake Michigan, but it is certainly not more than 20 feet. The Lower beach in Michigan occurs at intervals only. It consists of dunes and low sandy ridges lying back of the dunes of the present beach, which form a bold front along much of the Michigan shore. They are usually separated from these higher dunes by marshy belts, but sometimes lie immediately back of them. Their height seldom exceeds 40 feet, while the dunes along the shore are in some cases 125 feet or more in height.

The most southerly development of these older ridges in Michigan is found on the east side of the Michigan Central railroad in New Buffalo township, where they extend for more than a mile along the railroad. North from here no ridges of this epoch were noticed south of the clay banks, in Tp. 7 S., R. XXIV, but north from there to the vicinity of St. Joseph, dunes were noted at frequent intervals lying east of the belt along the shore. A similar distribution of two series of dunes was noted west of Carrot, in Van Buren county. Further north this Lower beach was not thus identified. Occasionally gravel deposits are exposed along the lake shore, capping the till at elevations of 10—20 feet, which may represent this epoch, but quite as frequently these deposits, as has been already noted, rise to heights corresponding with the elevation of the Middle beach (30—35 feet above Lake Michigan). The main development of the raised beaches, not only of this epoch, but of all epochs, is found in Illinois and Indiana, for it is only around the head of the lake that the land has gained more than it has lost since the epoch of the first (Upper) beach.

ON THE EMPLOYMENT OF THE METHOD OF LEAST SQUARES IN THE REDUCTION OF TRANSIT OBSERVATIONS.

By Prof. T. H. SAFFORD, Williamstown, Mass.

In longitude work upon the continent of Europe the polar stars employed to find the azimuth and collination of the transit are usually within a few degrees of the north pole. Each such star gives a value of the azimuth, and three are generally observed each evening, in reversed positions of the instrument; while the time-stars are, according to the instructions, twenty or more in number, arranged symmetrically about the polars, in such manner as to give opportunity for two exchanges of signals. The declinations of these time-stars are arranged at the same zenith distances south, as the polars are north of the zenith, so as to eliminate pivot-errors.

This arrangement, for latitudes near 50°, combines the following advantages:

1. The polar stars are slow enough in their apparent motions for a deliberate reversal during each of their transits.

2. The time-stars are in the declinations most favorable to accurate observation when they are equally distant from the zenith with the polars.

3. The reduction becomes extremely simple in execution, as the different instrumental corrections are directly determined and equations of conditions, to be solved by the method of least squares are not required.

For the more southern latitudes of Europe, which correspond to those of the northern part of the United States, these three conditions cannot be simultaneously fulfilled. If, for instance, the second condition be insisted upon, the first falls out, for latitude 43°, and *vice versa*. In order to fulfill this second condition the average declination of time stars must be taken at about 20°; and the polar-stars at 66°: which is too far south to accomplish the necessary reversals without hurry during the single transits.

Certain limitations, however, which are necessary in Europe, are needless in America. For instance, the greater length of the circuits over which very much of our telegraphic longitude work is done, renders it very difficult to observe the same stars at both stations. As our absolutely definitive reductions are not immediately necessary, the star-places used in any campaign can be left open for future improvement: when, for instance, geodetic measures shall be made over the whole territory. Again, the unsettled country in which much of the work is done renders it necessary for us to

adopt a different type of instruments from the European, lighter and more portable, less liable to injury in transportation; but, on the other hand, more care has to be exercised in so arranging our star-lists that all conceivable instrumental errors shall be eliminated; we cannot depend too fully upon one particular arc of the circle described by the telescope. All these things considered, it has been the practice of American observers to select their time and polar stars in a much wider range of declination than the Europeans employ; and to use the method of least squares in their reductions.

I have myself employed these methods, both of selection of stars and reduction, in second longitude campaigns; and have formulated for myself the practical rules to be followed. The earlier years of this work were spent in determinations at very distant points, accessible with difficulty, and with quite inferior instruments; so that, as they were also usually in bad repair, it required very careful handling to produce even tolerable results.

Later, in 1878, I had the use of an excellent transit instrument, which was in first-rate condition; and was then able to apply the rules which I had previously made for myself, to a better state of external circumstances. In the present paper I shall state the conditions for a good series of time-determinations in this country, as I now understand them, with especial reference to the western States and Territories, and the methods of reduction.

The observations to which I have last referred were made in 1878, at Ogden, Utah, in latitude 41° 13′. The results are given in the Report of the Chief of Engineers for 1879–80 (Executive Documents, 2d Session, 46th Congress, Vol. 5), pages 1983–5. It will be seen that during a space of 2½ months, from July 25th to October 10th, 74 days in all, there were 67 determinations of time. Signals were exchanged on 26 nights with the regular observers of Captain Wheeler's survey; and the observations on these nights reduced by the method of least squares; all these calculations, as well as the preliminary ones necessary for the other nights, were completed within the two months after the first exchange, August 12th, so that the method of reduction is not too complicated to be practicable.

The following would be, in my judgment, an advantageous selections of stars for a latitude 41° — 44°; the group is arranged nearly as at Ogden, and differs from my ordinary arrangements in those times only because I had then fewer close polar stars available. The stars are taken from the Berlin Jahrbuch, or other ephemerides, and from my catalogue of 2018 stars published by the Engineer Bureau:

Name of Star.	A. R. 1885.0	Decl. 1885.0	Remarks.
Cassiopeiæ	0 26 28	+ 62 18	
Andromedæ.....	0 30 44	+ 33 5	
55 Piscium	0 33 52	+ 20 48	
o Cassiopeiæ	0 38 19	+ 47 39	
δ Piscium	0 22 43	+ 6 57	
Cephei 43 H.....	0 53 12	+ 85 38	Reverse on this star.
ε Piscium	1 2 27	+ 5 2	
τ Piscium	1 5 20	+ 29 29	
α Piscium	1 7 30	+ 23 59	
f Piscium.....	1 11 52	+ 3 1	
ψ Cassiopeiæ	1 17 41	+ 67 31	

It will be noticed that I have introduced no stars at lower culmination. The reason for this is, that unless they are very near the pole, the azimuth co efficient which they furnish is positive in sign, and the stars which balance them as to the sign of this co-efficient do not as to the form of the pivots. In other words, a combination of stars below and above pole would give the clock correction with a large probable error and with a danger of constant error, while a combination of stars below pole with those at corresponding south zenith distances would be far less advantageous, owing to the identity of sign in the azimuth co-efficient, and its greater magnitude for the southern stars, than a combination of stars above pole on the north side with the ordinary northern time-stars.

When the least square reduction is made, the theoretical test of a good combination is obtained by Jacobi's theorem, which I quote below; the practical test by the quotient.

$$\frac{\text{Weight of clock-correction.}}{\text{Number of transits}}$$

which should approach the weight of one transit of a zenith star: Practically I usually employ the following formula for the weight or of one complete transit (on 5 or more wires, or 7 or more, according to the way the diaphragm is arranged).

$$w = \frac{1.3}{1 + 0.3 \text{ Sec.}^2\delta}$$

For latitude 42° 42′ 5, this gives the weight of a zenith star equal to 0.836; in general it is easy so to arrange the groups that the weight of the clock correction from 10 stars shall be 7 at least; but where lower culminations and southern stars are freely employed this number frequently is reduced to 5 or less. That is to say, 10 stars well arranged give as good a clock correction as 14 ill arranged; and waste of time spent in computation is thus avoided. The few extra minutes lost in observations are usually of less account; and are perhaps compensated by the greater pains necessary beforehand. In order to modify the weight-formula to advantage more

observations are needed, which I intend to make with a portable instrument now constructing for Williams College Observatory; the field observations have confirmed it with sufficient certainty for my purposes. For in my least square reductions I have pursued the course so strongly recommended by Gauss (Astr. Nachrichten v. 5, cols. 227 following; Méthode des moindres carrés, mémoires traduits par J. Bertrand, p. 163) of determining in advance approximate values of the unknowns, and using the least squares only to find minute corrections. And the following are the results for the clock-corrections of the dates in the Ogden campaign, as published in the Report before alluded to:

Date.	Correction to provisional result.	Date.	Correction to provisional result.
	s.		s.
Aug. 12.....	−0.008	Sept. 20.....	+0.001
19.....	−0.021	21.....	−0.020
21.....	−0.003	22.....	+0.001
26.....	−0.010	26.....	+0.001
28.....	−0.006	27.....	−0.008
Sept. 5.....	+0.016	30.....	+0.011
7.....	+0.010	Oct. 1.....	−0.002
8.....	0.000	3.....	−0.009
10.....	−0.010	5.....	−0.005
11.....	+0.017	6.....	−0.005
12.....	+0.009	7.....	−0.003
13.....	+0.010	8.....	−0.013
17.....	−0.031	10.....	−0.007

The total effect upon the longitudes of the application of least squares, consists in the differences of their corrections for the stations. The observors at the corresponding stations in this campaign had worse instruments than I, and were not so scrupulous in arranging their star lists; so that the corresponding corrections came out rather larger. Their time determinations did not suffer sensibly from this cause, however; as both were experienced observers. The average without regard to sign of the 26 numbers given above — each of which, with trifling exceptions is the result of two groups of stars — is $0.^s0091$: and the probable error of one preliminary solution $\pm 0.^s0077$; or for a single group of 10 stars $\pm 0.^s011$.

It is evident, then, that if the weights are assigned by my formula with approximate corrections — so, for instance as to make sufficient distinction between a very slow-moving and a quiet-moving star — there need be no fear that it is not correct enough. The objections to the old process of giving all stars a weight unity is that the polars of high declination dominate too much in azimuth; this process is about equivalent to leaving out the quicker-moving stars north of 65° altogether.

Another practice which is quite common is altogether meaningless. When the weights are approximately correct there is no necessity of omit-

ting the polar stars in arranging the final table of clock corrections. Each star, quick-or slow-moving, should go in, with its proper weight to the clock-correction The method of least squares gives, namely: the *most probable* values of all the unknowns; and a *more probable* one than this cannot be obtained in any other way, unless the original system of weights be altered. But this would involve a contradiction; the weight, according to definition, refers not to the use to be made of the observation, but to the measure of its precision. The following example taken from my work on the longitude campaign of 1878 will illustrate several points of this paper.

The observer at Fort Bliss (latitude 31° 45′) frequently inserted stars subpole in his determinations. As a consequence the weight of the final time determination was less, proportionately, than it otherwise would have been; for a zenith star my formula would give

$$\frac{1.3}{1 + 0.\,z\,\sec^2 31° 45'} = \frac{1.3}{1.415} = 0.919$$

But the group after signals on September 8th contains 11 stars, g'ving a final weight of 6.92; or about that of 8 or 9 stars nearer the zenith; two stars are below pole, and therefore less advantageous. The results of the individual stars (those north of 65° are marked with an asterisk; these are now between 45° and 65°) are as follows:

	Clock Corr.	Clamp.
	m s	
θ Aquarii	—1 24.79	W
γ Aquarii	—1 24.89	W
π Aquarii	—1 24.82	W
Draconis 9 H. sp	—1 25.28*	W
Groomb. 3834	—1 25.39*	W
ζ Pegasi	—1 24.75	W
λ Pegasi	—1 24.83	E
τ Cephei	—1 25.07*	E
Bradley 1508 sp	—1 25.37*	E
o Andromedae	—1 25.09	E
α Pegasi	—1 24.74	E

The least square solution gives the mean clock-correction —1′ 24″.888, but this includes, with their proper weight, the stars marked with an asterisk. If we omit these, and give all others a weight unity we shall have —1′ 24″.844, or +0″.044 more. But it is plain from least square solution that some cause affects the observations north of the zenith, probably wear of pivots [1]; and the mean of the 6 stars south of the zenith gives —1′ 24″.803;

[1] This is confirmed by the other dates when the same instrument was employed.

the three north of the zenith and above pole $-1'\ 25''.183$; and the zenith distances are nearly equal for these two groups. It is plain from this that the least square value $-1'\ 24''.888$ is probably nearer correct than the greater (algebraic) value $-1'\ 24''.803$; as it ought to be. In other words, the exclusion from the final clock corrections of the quick moving polar stars renders the elimination of pivot error very questionable; as, in fact, does the employment of groups not sufficiently well-balanced.

The simpler method of reduction, which gives the instrumental corrections separately, without least squares, really assigns to the polar stars their proper weight; especially if they are all observed at upper culmination, as the German instructions recommend. For in this case the final clock corrections from each time star are actually reduced by interpolation to the zenith, as may be seen by using Dr. Braun's graphical method given in vol. 109 (No. 2595) of the Astronomische Nachrichten. So that in the previous example it is not surprising that the preliminary solution gave a value ($1'\ 24''.90$) very nearly equal to the final result. Nor is it very plain that the least square method is absolutely indispensable; I have employed it in my reductions without objection, although I have never known a case in which it materially aided in producing a better agreement in the resulting longitude. The chief argument in its favor here is that it renders it unnecessary to restrict the selection of stars to a narrow range, while it removes the arbitrary character of the reductions when this restriction has not been carried into effect. The chief objection to the method of least squares is that observers who are not both experienced and careful sometimes permit a blind faith in it to mislead them in preparing their working lists; and forget the necessity of making observations enough and of the right quality, which is no less when least squares are used in reductions than at any other time.

Jacobi's theorem is in substance the following; and bears directly upon the point in question:

In order to obtain the least square result for any unknown of m equations with a less number of unknowns, we solve all possible combinations n by n of the m equations, and multiply each such result for this unknown by the square of the corresponding determinant. We add all these products together and divide their sum by the sum of the squares of the determinant factors; the quotient will be the least square result sought for.[1]

To a least square result, then, unfavorable combinations furnish small contributions relatively to favorable ones; and if the favorable ones cannot be made, the unfavorable ones are better than nothing. Stars below pole are the proper ones to employ in combination with those above, when the azimuth is the unknown most needed, as in setting up a meridian mark; but for time-determinations proper the best combination is that of polars above pole with time-stars at nearly equal zenith distances on the other side.

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[1] Jacobi, De Formatione et Proprietatibus Determinantium: Crelle's Journal.

I have annexed to this paper, a table for Ogden observatory, latitude 41° 13′ 8″.6, which is calculated according to the formula.

$$p = \frac{1.3}{1 + 0.3 \sec^2 \delta}$$

$$A = \frac{\sin(\varphi - \delta)}{\cos \delta}$$

$$C = \frac{1}{\cos \delta}$$

The columns p, C p, C_2 p hold good for any station; the values of A p, A_2 p, A C p must be recalculated for every new latitude. But I have not omitted them, as their values will serve as a control for a good many places near the same parallel. The numbers are given to four decimals, to enable the computor to interpolate readily to three.

The 52 nights out of 78 upon which signals were not exchanged at Ogden, afforded an excellent opportunity for the criticism of the instrument. A peculiarity of much far western longitude work is that the telegraph lines are in bad order much of the time, and do not afford opportunities for long exchanges. On some nights of the exchanges with Fort Bliss (Texas), it was impossible to get a circuit through on the more direct route, by way of Cheyenne, Denver, and Santa Fé, and recourse was had to a line of 2,000 miles in length via San Francisco, Southern California, and Arizona. The time expended while waiting is, under such circumstances, best applied to the study of the peculiarities of the instrument.

In conclusion, I will indicate the principal points of this paper as a summary of directions for the determination of time in latitudes 25° to 49°.

1. A group of time-stars should contain about 10 stars in all, with one reversal.

2. It should contain no more than two or three polars; one of which may be within 10 degrees of the pole.

3. Stars north of the zenith, not polars, should be included; and may take the place of polars to some extent.

4. Lower culminations should in general be avoided; and time-stars far south of the zenith.

5. The stars of a group should so balance at the zenith that the co-efficient of azimuth and collination in the normal equation for clock-correction should be very small, and the weight of the clock-correction large in proportion to the number of stars.

6. With proper blank forms the preliminary reduction without least squares can be very simply effected, and this should always be done.

7. The least square deduction is of little benefit except in removing the effect of any arbitrary assumptions in the previous process; and should be

employed only for the signal-nights, or other times when the last degree of precision is required.

8. In making the least square reductions the weights at different declinations should be combined with the coefficients for azimuth and collination; and the unknowns should be in the form of corrections to the values derived from the preliminary reduction.

Jacobi's Theorem.

Note.—[I give this in the original Latin, as it is very important, and seems not to be well known to mathematicians.]

Proponantur aequationes:

$$ax+a'x,+a''x_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots +a^{(n)}x_n =l$$

$$a_1x+a'_1x,+a''_1\,x_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots +a,^{(n)}\,x_n =l_1$$

$$a_p\,x+a'_p\,x_1+a''_p\,x_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots +a_p{}^{(n)}x_n =l_p$$

Quarum numerus incognitarum numerum excedat; e quolibet systemate n+1 aequationum praecedentium valor incognitae eruatur atque per quadratum Determinantis eius systematis, RR, multiplicetur; quibus factis pro singulis aequationum propositarum combinationis omnium illorum productorum summa per summam omnium RR dividatur: eruitur incognitae valor idem atque invenitur, si aequationes propositae per Methodum Minimorum Quadratorum tractantur."

Observandum est, valores omnium incognitorum qui ex eadem aequationum propositarum combinatione proveniant secundum Prop. praec. per *eandem* quantitatem RR multiplicare, quam ideo in applicationibus ad *Methodum Minimorum Quadratorum convenit appellare Pondus Combinationis*, a pondore valoris incognitae bene distinguendum.

The theorem is thus given in Crelle, vol. 22, p. 316; it is also given independently by Mr. J. W. L. Glaisher in Vol. 40, of the Monthly Notices, p. 607.

SQUARES AND PRODUCTS OF LEAST SQUARE CO-EFFICIENTS FOR TIME — OGDEN.

Decl.	P	A p	C p	A_2 p	A C p	C_2 p
0°	1.0000	+.6589	+1.0000	.4342	+.6589	1.0000
	−1	131	+1	−172	−130	+2
1	.9999	.6458	1.0001	.4170	.6459	1.0002
	2	133	2	168	130	7
2	.9997	.6325	1.0003	.4002	.6329	1.0009
	3	134	4	166	129	12
3	.9994	.6191	1.0007	.3836	.6200	1.0021
	5	134	6	164	129	16
4	.9989	.6057	1.0013	.3672	.6071	1.0037
	7	136	8	160	127	22
5	.9982	.5921	1.0021	.3512	.5944	1.0059
	7	137	9	158	128	26
6	.9975	.5784	1.0030	.3354	.5816	1.0085
	10	138	10	155	127	31
7	.9965	.5646	1.0040	.3199	.5689	1.0116
	10	139	12	152	128	35
8	.9955	.5507	1.0052	.3047	.5561	1.0151
	11	140	14	148	127	41
9	.9942	.5367	1.0066	.2897	.5434	1.0192
	13	141	16	147	128	48
10	.9929	.5226	1.0082	.2750	.5306	1.0240
	15	143	17	144	128	48
11	.9914	.5083	1.0099	.2606	.5178	1.0288
	17	144	19	141	129	56
12	.9897	.4939	1.0118	.2465	.5049	1.0344
	19	145	20	139	129	61
13	.9878	.4794	1.0138	.2326	.4920	1.0405
	19	147	22	135	130	67
14	.9859	.4647	1.0160	.2191	.4790	1.0472
	22	148	24	133	132	71
15	.9837	.4499	1.0184	.2058	.4658	1.0543
	23	149	25	130	133	78
16	.9814	.4350	1.0209	.1928	.4525	1.0621
	25	151	27	127	134	83
17	.9789	.4199	1.0236	.1801	.4391	1.0704
	27	153	29	123	136	89
18	.9762	.4046	1.0265	.1678	.4255	1.0793
	28	153	30	121	138	95
19	.9734	.3893	1.0295	.1557	.4117	1.0888
	31	156	31	117	140	101
20	.9703	.3737	1.0326	.1440	.3977	1.0989
	32	157	33	115	142	107
21	.9671	.3580	1.0359	.1325	.3835	1.1096
	34	159	35	110	145	114
22	.9637	.3421	1.0394	.1215	.3690	1.1210
	36	160	36	107	147	121
23	.9601	.3261	1.0430	.1108	.3543	1.1331
	38	162	38	104	151	127
24	.9563	.3099	1.0468	.1004	.3392	1.1458
	41	164	39	100	154	135
25	.9522	.2935	1.0507	.0904	.3238	1.1593
	42	166	40	95	157	142
26	.9480	.2769	1.0547	.0809	.3081	1.1735
	45	168	42	92	162	149
27	.9435	.2601	1.0589	.0717	.2919	1.1884
	47	170	43	87	165	158
28	.9388	.2431	1.0632	.0630	.2754	1.2042
	50	171	45	83	170	165
29	.9338	.2260	1.0677	.0547	.2584	1.2207
	52	174	45	79	175	174

SQUARES AND PRODUCTS OF LEAST SQUARE CO-EFFICIENTS FOR TIME — OGDEN.

Decl.	P	A p	C p	A_2 p	A C p	C_2 p
30	.9286	.2086	1.0722	.0468	.2409	1.2381
	55	175	47	72	180	183
31	.9231	.1911	1.0769	.0396	.2229	1.2564
	58	178	48	68	185	191
32	.9173	.1733	1.0817	.0328	.2044	1.2755
	60	180	49	63	192	201
33	.9113	.1553	1.0866	.0265	.1852	1.2956
	63	182	50	57	197	211
34	.9050	.1371	1.0916	.0208	.1655	1.3167
	66	183	51	51	205	221
35	.8984	.1188	1.0967	.0157	.1450	1.3388
	70	186	52	43	211	232
36	.8914	.1002	1.1019	.0114	.1239	1.3620
	73	188	52	39	219	242
37	.8841	.0914	1.1071	.0075	.1020	1.3862
	76	189	52	31	227	254
38	.8765	.0625	1.1123	.0044	.0793	1.4116
	79	192	53	23	236	265
39	.8686	.0433	1.1176	.0021	.0557	1.4381
	84	194	53	17	245	+278
40	.8602	.0239	1.1229	+.0007	.0312	1.4659
40°	.8602	+.0239	+1.1229	.0006	+.0312	1.4659
	—87	—196	+54	— 6	— 225	+ 291
41	.8515	+.0043	1.1283	.0000	+.0057	1.4950
	91	197	53	+ 3	265	304
42	.8424	—.0154	1.1336	.3003	—.0208	1.5254
	95	200	52	12	276	317
43	.8329	.0354	1.1388	.0015	.0484	1.5571
	100	201	52	22	288	332
44	.8229	.0555	1.1440	.0037	.0772	1.5903
	104	203	50	34	300	347
45	.8125	.0758	1.1490	.0071	.1072	1.6250
	109	204	50	44	312	362
46	.8016	.0962	1.1540	.0115	.1384	1.6612
	113	205	48	57	327	379
47	.7903	.1167	1.1588	.0172	.1711	1.6991
	119	207	45	71	342	395
48	.7784	.1374	1.1633	.0243	.2053	1.7386
	123	207	44	83	357	412
49	.7661	.1581	1.1677	.0326	.2410	1.7798
	129	208	40	99	373	430
50	.7532	.1789	1.1717	.0425	.2783	1.8228
	135	208	37	114	390	449
51	.7397	.1997	1.1754	.0539	.3173	1.8677
	140	208	33	131	408	468
52	.7257	.2205	1.1787	.0670	.3581	1.9145
	147	207	28	148	427	487
53	.7110	.2412	1.1815	.0818	.4008	1.9632
	152	207	23	168	447	508
54	.6958	.2619	1.1838	.0986	.4455	2.0140
	158	205	17	187	469	529
55	.6800	.2824	1.1855	.1173	.4924	2.0669
	165	203	10	208	489	549

SQUARES AND PRODUCTS OF LEAST SQUARE CO-EFFICIENTS FOR TIME — OGDEN.

Decl.	P		Ap		Cp		A_2p		ACp		C_2p	
56	.6635	172	.3027	200	1.1865	+ 2	.1381	231	.5413	513	2.1218	571
57	.6463	178	.3227	197	1.1867	—6	.1612	254	.5926	536	2.1789	594
58	.6285	184	.3424	193	1.1861	16	.1866	279	.6462	561	2.2383	615
59	.6101	192	.3617	188	1.1845	27	.2145	305	.7023	587	2.2998	638
60	.5909	198	.3805	182	1.1818	38	.2450	333	.7610	613	2.3636	661
61	.5711	205	.3987	174	1.1780	52	.2783	362	.8223	640	2.4297	684
62	.5506	212	.4161	166	1.1728	67	.3145	392	.8863	668	2.4981	705
63	.5294	218	.4327	157	1.1661	83	.3537	423	.9531	697	2.5686	728
64	.5076	225	.4484	145	1.1579	100	.3960	457	1.0228	725	2.6414	748
65	.4851	230	.4629	133	1.1479	119	.4417	490	1.0953	754	2.7162	769
66	.4621	236	.4762	119	1.1360	139	.4907	526	1.1707	784	2.7931	788
67	.4385	242	.4881	102	1.1221	161	.5433	561	1.2491	812	2.8719	804
68	.4143	246	.4983	85	1.1060	186	.5994	598	1.3303	840	2.9523	820
69	.3897	250	.5068	66	1.0874	211	.6592	635	1.4143	867	3.0343	834
70	.3647	253	.5134	43	1.0663	238	.7227	672	1.5010	894	3.1177	843
71	.3394	255	.5177	—21	1.0425	268	.7899	710	1.5904	918	3.2020	850
72	.3139	256	.5198	+ 5	1.0157	297	.8609	746	1.6822	940	3.2870	854
73	.2883	256	.5193	33	.9860	329	.9355	781	1.7762	959	3.3724	853
74	.2627	254	.5160	62	.9531	363	1.0136	816	1.8721	975	3.4577	846
75	.2373	251	.5098	94	.9168	396	1.0952	847	1.9696	988	3.5423	837
76	.2122	246	.5004	127	.8772	431	1.1799	877	2.0684	996	3.6260	819
77	.1876	239	.4877	162	.8341	466	1.2676	903	2.1680	998	3.7079	797
78	.1637	232	.4715	198	.7875	501	1.3579	925	2.2678	997	3.7876	767
79	.1407	220	.4517	— 234	.7374	— 536	1.4504	943	2.3675	988	3.8643	782
80	.1187		—.4283		.6838		1.5447		—2.4663		3.9375	

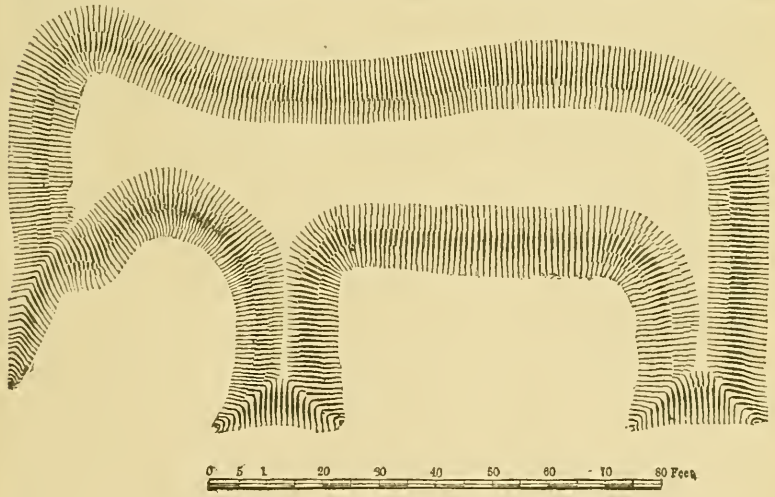
SQUARES AND PRODUCTS OF LEAST SQUARE COEFFICIENTS FOR TIME — OGDEN.

Decl.	P	A p	C p	$A_2 p$	A Cp	$C_2 p$
80°	0.1187	—.4283	+.6838	1.5447	—2.4663	3.9376
	—207	+ 273	—570	+ 956	+ 973	+ 689
81	0.0980	.4010	.6268	1.6403	2.5936	4.0065
	192	310	603	963	951	640
82	0.0788	.3700	.5665	1.7366	2.6587	4.0705
	175	347	633	964	923	584
83	0.0613	.3353	.5032	1.8330	2.7510	4.1289
	163	385	662	958	888	521
84	0.0457	.2968	.4370	1.9288	2.8398	4.1810
	12	419	686	945	844	454
85	0.0321	.2549	.3684	2.0233	2.9242	4.2264
	114	454	709	925	795	378
86	0.0207	.2095	.2975	2.1158	3.0037	4.2642
	89	484	728	897	738	299
87	0.0118	.1611	.2247	2.2055	3.0775	4.2941
	65	513	741	865	676	217
88	0.0053	.1098	.1506	2.2920	3.1451	4.3158
	40	538	751	826	608	131
89	0.0013	.0560	+0.0755	2.3742	3.2059	4.3289
	—13	560	755	776	536	+44
90	0.0000	0.0000	0.0000	2.4518	3.2595	4.3158
	+13	577	755	722	460	—44
89 sp	0.0013	+0.0577	—0.0755	2.5240	3.3055	4.3289
	40	590	751	664	381	131
88 sp	0.0053	.1167	.1506	2.5904	3.3436	4.3158
	65	599	741	603	301	217
87 sp	0.0118	.1766	.2247	2.6507	3.3737	4.2941
	89	603	728	634	220	209
86 sp	0.0207	.2369	.2975	2.7041	3.3957	4.2642
	114	603	709	467	140	378
85 sp	0.0321	.2972	.3684	2.7508	3.4097	4.2264
	136	598	686	397	+60	554
84 sp	0.0457	.3570	.4370	2.7905	3.4157	4.1810
	156	591	662	327	—15	521
83 sp	0.0613	.4161	.5032	2.8232	3.4142	4.1289
	175	578	633	257	88	584
82 sp	0.0788	.4739	.5665	2.8489	3.4054	4.0705
	192	564	603	187	158	640
81 sp	0.0980	.5303	.6268	2.8676	3.3896	4.0065
	+ 207	+ 544	—570	+ 121	—222	—689
80 sp	0.1187	+.5847	—.6838	2.8797	—3.3674	3.9376

THE SO-CALLED ELEPHANT MOUND IN GRANT COUNTY, AND EFFIGIES IN THE REGION SURROUNDING IT.

By Rev. S. D. PEET.

The survey of the mounds in the neighborhood of the so-called elephant effigy, which was undertaken under the auspices of the Wisconsin Academy of Arts, has not, for various reasons, been reported until now. The survey was conducted by the writer mainly during the year 1885, but a trip previous to that in 1882, and subsequent to it in 1886, are to be taken into the account. It is very fortunate that the Society recommended this survey at the time that it did, as many of the mounds then in a good state of preservation, have been destroyed since. A railroad has been built along the valley of the Mississippi and the track has been laid in the very midst of the mounds that were surveyed. Before giving a description of the survey we propose



Scale 24 feet to the inch.

Fig. 1.

to give a history of this effigy. The discovery of the elephant effigy was made by Mr. Jared Warner, of Patch Grove, Grant County, and the account was first published in the Smithsonian report of 1872, with a cut, an electrotype. (See Fig. 1). Mr. Warner says "this effigy was situated on the high sandy bottom lands of the Mississippi, on the east side, about eight miles below the mouth of the Wisconsin river. There are on each side of

the mound, some fifteen or twenty rods distant, sandy, grassy ridges, some fifteen feet higher than the land about the mound; the mound is, therefore in a shallow valley, sloping gently to the Mississippi river, and only about eight feet above high water. Its total length is 135 feet; from hind feet to back, sixty feet; from fore feet to back, sixty-six feet; width across fore legs, twenty-one feet; across hind legs, twenty-four feet; space between hind and fore legs, fifty-one feet; from end of proboscis to fore legs, thirty-nine feet; across the body, thirty-six feet; general height of body above surrounding ground, five feet. The head is large, and the proportions of the whole so symmetrical that the mound well deserves the name of the "Big Elephant Mound." Next to Mr. Warner was Mr. Moses Strong, who published an account of the effigy and the mounds surrounding it in the Smithsonian Report for 1876. Mr. Strong was at the time connected with the Geological survey of the state, and took in the exploration of the mounds incidentally. He describes a group of mounds on the Mississippi bottom situated on Sec. 17, N. E. quarter Tp. 5, R. 6 W. [The effigy is on Sec. 21].

Mr. Strong says, "following the course of the Mississippi about a quarter of a mile southeast of the preceding locality, numerous long mounds are seen arranged in several rows parallel to each other and to the river. They are situated in the cultivated fields and are nearly obliterated. At the time these localities were visited the valley was covered by a crop of standing corn which rendered it difficult to find them; and it is probable that many exist which were not noticed. No circular or effigy mounds were found in connection with them. Continuing down the valley we come to a group in which the three kinds of mounds are well represented. They lie upon the alluvial bottom quite near a bayou of the Mississippi and none of them are more than eight feet above high water mark, while those in the southern part of the group are not more than three feet. In this group where all kinds are represented, there seems to be a separation of the long and round mounds from each other. There is nothing of peculiar interest in the occurrence of the long and circular mounds, but we have here two quite singular effigies. The central one of the group is evidently intended to represent a bird with the wings spread in the act of flying; the head is directed to the south. The wings measure ninety-four feet each way from the center of the body to their extremities, and the length of the tail is sixty-five feet. It is quite a large and well-formed effigy and is different from the other bird mounds in having an angle in the wings. Situated at the northern end of the group is the most interesting effigy mound any where observed. A description of it by Mr. Warner, of Patch Grove, was published in the Smithsonian Report of 1872, page 416. It is known as the "Elephant Mound," and as it lies upon the ground it resembles an elephant or mastodon, much more closely than any other animal, and the resemblance is much more perfect in this instance than in other effigies. This mound, in common with all the rest in the group, has been under cultivation; and on account of its size, special efforts have been made with plows

and scrapers, to bring it to the level of the adjacent field. Its size alone has protected it. These efforts have resulted in diminishing its height, increasing its width and general circumference, and rendering its outline somewhat indistinct so that it was difficult to make exact measurements."

The writer first visited the effigy six years after Mr. Strong made his report. It was then nearly obliterated. Subsequent to this first visit the employes of the Ethnological Bureau surveyed some groups of mounds and effigies on the bluffs, three miles north of the effigy, but their report has not yet been published. Subsequent to their survey, Mr. Brown, a student in Wisconsin University, and an assistant of Prof. Conover, of Madison, Wis., was employed to make measurements of the mound, so that a cast might be made of it and put on exhibition with the Smithsonian relics, at the New Orleans Exposition, during 1885. The exploration of the writer under the auspices of the Society was subsequent to all these. It embraced not only the so-called elephant effigy, but all the mounds in the vicinity. The mound was again measured, making the fourth actual survey.

The following is the result of the personal examination of the mound at this time: When the the writer visited the locality in 1885, only two mounds out of the whole group were left, one which is described as the bird effigy, the other known as the elephant mound. Both of these had been nearly plowed down, but owing to peculiar circumstances were plainly visible. During the spring preceding the visit, the water from the bayou had set back into the swail and remained standing upon the low ground, but did not quite reach to the summit of the effigies. There was at the time a growth of clover upon the soil, but this was drowned out by the flood except where the effigies stood. As a result the effigies were covered with the clover, but the surrounding ground was either bare or had a slight covering of grass upon it. Standing upon the summit of the hill or ridge adjoining, we were able to look down upon the swail and see the outlines of the two effigies, the dark color of the clover contrasting with the light shade of the grass. The shapes of the two effigies were easily made out. The bird had its head toward the southwest, its wings extending across the swail, nearly reaching the foot of the sand ridges. The so-called elephant effigy had its head in the same direction, to the southwest, but its body was lengthwise of the swail, its heavy legs extending toward the southeast. The two effigies were in contrast, as the bird had long, narrow wings, small body and neck, while the animal had a broad, heavy body, almost square in shape, with its legs unusually wide and clumsy. On approaching nearer the outlines of the effigy were not so distinct as when at a distance, though the clover seemed to give it an elevation. The real mound was but slightly raised above the surrounding surface and there were no sharp lines to the effigy.

The measurement of the mound was very unsatisfactory on account of the condition in which it was. The figures would not represent the mound as it was when first seen, and would be very unreliable as there were no

points from which to begin or end the measurement. One thing was noticeable, however, to the eye and confirmed by measurements. There was no proboscis to the figure. The point which extended from the nose was indistinct and appeared to be the result of the washing of the sandy soil down to the level. It was evident that that which was taken for the proboscis was never long enough or wide enough to properly represent that part. The writer has had considerable experience in tracing out mounds which were nearly obliterated and ordinarily would be able to describe the figure from what might be called the shadow of it. The peculiar color of the soil, which originally belonged to the figure, and the indescribable shading of this soil into the undisturbed surface of the soil or ground surrounding it, will ordinarily give the figure to the eye, even if the measurements should be unsatisfactory. The impression formed by this effigy, and especially the part of it which is the distinctive and deciding point was that the proboscis was never there. The writer hesitates to put himself on

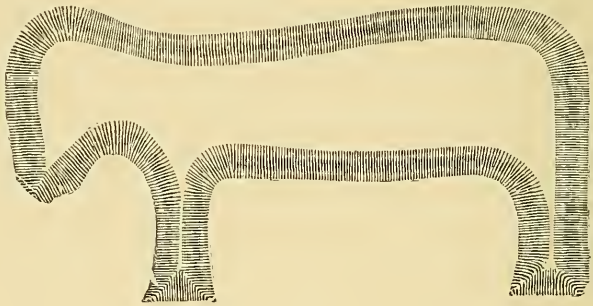
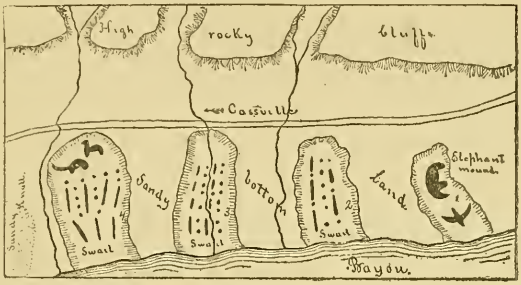


Fig. 2.

record as contradicting such reliable persons as have given a description of the effigy to the public. There is this, however, to be considered. If the engraved figure which was made according to a scale from the measurements of Jared Warner, and those accompanying him, should be taken, and the narrow, pointed snout left off from the figure as uncertain, we should have an effigy which bears very little resemblance to the elephant. (See Fig. 2.) On the other hand, if any one undertakes to draw the figure so that it shall have the trunk in its usual place and shape he would have to completely overdraw and distort the figure, as it is now. This view led the writer, at his first visit, to doubt the intent of the effigy, and every other visit has increased the doubt. The examination of the effigy itself proved so unsatisfactory that the writer determined to study and survey the groups adjoining, and therefore a description of these groups is added to the report. It should be said that the study was given first to the groups on the bottom-lands, then extended to the bluffs, and afterward the whole region was traversed and examined, until all the groups in the vicinity were explored. These will be given in their order.

We call attention to the mounds in the immediate vicinity of the so-called elephant effigy. The writer traversed the region in a reverse order or direction from that which Mr. Strong pursued, but was able to identify some of the groups which he mentions. There were no effigies in the vicinity, except two, which were very nearly obliterated.



There were several groups in the swails which cut through the bottom land in this vicinity, and to these we first gave our attention. The swails are the dry beds of water courses, which in the time of heavy rains, flow out from gorges or so-called "coolies" in the bluff toward the bayous of the river. These swails are generally in a direct line with the openings in the bluffs, and extend from the foot of the bluffs across the sandy bottom land or terrace to the bayous. They are so much below the surface that the mounds in them are not seen until one suddenly comes upon them as he reaches the edge of the swail. The swail in which the so-called elephant mound was placed was not exactly in a line with the rest but angles to the southwest, and where the effigy is, was much deeper than the other swails. The method of arranging these mounds in the swails was peculiar. They were placed in parallel rows which extended lengthwise of the swail, sometimes three or four rows in each swail and in some of the swails as many as thirty or forty mounds in a group. Four such groups were discovered by the writer in passing from the elephant mound, northward, the most of them composed of alternate rows of long mounds and round mounds, arranged in parallel lines. There were no effigies in the swails, merely round and long mounds. The only place where effigies were discovered was on the terrace or bottom land outside of a swail about a mile north from the elephant effigy, on what was called the Bagley place. These effigies were nearly obliterated but seemed to have been very large in size, and possibly one or two of them may have resembled in shape the effigy which is called the elephant. But the figures were so far gone that no effigy could really be traced.

It should be said of these that if one were determined to make out the existence of the elephant and camel effigies, the shadowy shape left upon the surface of the soil might easily satisfy him. There were two

figures. One with a large body and a snout (Fig. 3) extending from it to a great length, curved somewhat like the horns of the mastodon. The other with a body slimmer and not so large, but with a long neck protruding above the body. Still no man of candor would undertake to build up a theory on so shadowy a foundation as this, for we have only to reverse the figure to make it represent a gigantic raccoon instead of an elephant, and the theory is upset. In reference to the different groups of mounds, which were found in the swails, we should say that they belonged to the same age as the so-called elephant effigy, and yet there was a fresh look to them, as if they were of a comparatively recent date. It would hardly seem possible for mounds to be preserved in the sandy soil, during the many centuries which have elapsed since the mastodon became extinct, and the theory that they were built at the time of the mastodon seems untenable. The evidence that they belonged to the same time and belonged to the same people, is that they were situated in the same kind of swails and were arranged in the same order, and at the same time were near the group in which the effigy is found. The probabilities then are against this effigy being an elephant, and the figure is given only to show how easily one may be mistaken.

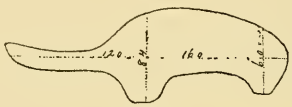
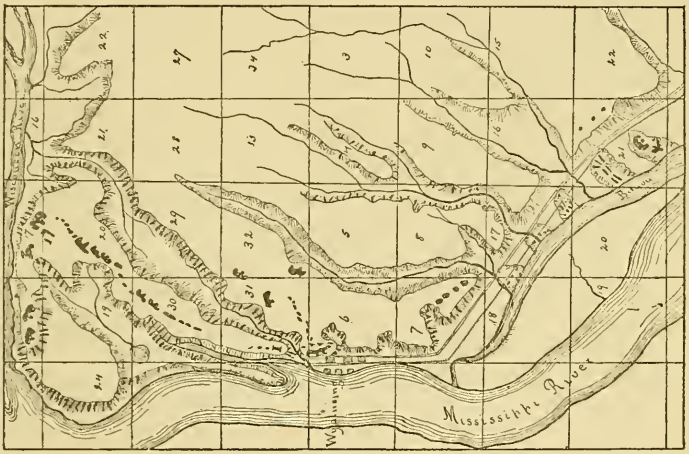


Fig. 3.

The examination of the effigies and mounds on the bluffs followed that of the mounds on the bottom lands. It should be said that the bluffs, in this region, are very precipitous, and are broken into narrow and crooked ridges, on either side of which the water courses through deep gorges, down to the streams and water-spouts, until it makes its way to the bayou and to the river. The only way to reach the summit is to climb the precipitous face of the cliff, or to follow up the narrow and crooked valley of the stream to the plateau above, and then retrace one's steps out on the level to the edge of the bluffs. When one reaches the summit from either direction he is pretty sure to find mounds on the ridge. They are hidden from view until he reaches the hill-top, but they run in long lines from the edge of the cliff back to the plateau at the head of the gorges. A perfect net-work of these long mounds, round mounds, and effigies, was discovered, nearly every ridge having its own line, but some of the ridges having lines that were connected. They seem to be the most numerous on the bluffs which intervene between the Wisconsin and Mississippi rivers, and yet we understand that others are to be seen on the bluffs immediately overlooking the so-called elephant effigy. The lines of mounds extend to great distances, some of them three or four miles in length, and it was not difficult to imagine them to be sort of elevated roadways con-

necting lookout stations, on which warriors might watch the enemy coming down the Wisconsin river, or up the Mississippi river, and so notify the people residing in the village of the danger that threatened them. At least the lines of long mounds and round mounds seem to follow along the ridges which intervene between the two rivers, as if the object was to connect the valleys by lookout stations and elevated roadways. The view from the edge of the high bluffs is always extensive and commands the bottom lands below. There are, however, lines which extend from the face of the bluffs back to the prairies and open plateau in the interior, and an explanation of these would be that they were elevated ways on which hunters might run while watching the game that should be driven from the plateau down the gorges to the bottom land below.



Map 1.

The explanation, however, is not the purpose of the survey, but merely the statement of the facts. The long lines of mounds on the bluffs, all seem to have effigies, and the object was to ascertain what kind of effigies they were. The lines which were followed out were more or less directly connected with the group in which the elephant effigy was situated, at least they were on the bluffs which overlooked the same terrace and we understood some of them were on the edge of the same gorge through which the water would make its way, while passing through the swail where the effigy mound is seen. The elephant effigy forms the southernmost limit; but the northern limit of the long mounds and effigies upon the bluffs is seven or eight miles distant, on the Wisconsin river. The groups on the bottom lands and on the bluffs adjoining, seem to form connecting links, so that if one were to study one group, he needed to study all. There are three or four lines of effigies on the bluffs and three or four groups of parallel mounds on the bottom lands. One object was to see if there was any connection between the different parts of this system. Another object was to

examine the different effigies on the bluffs and compare them with those on the bottom lands and ascertain the character of both. A third object was to ascertain whether there was any effigy on the bluffs which in any way had resemblance to the so-called elephant effigy on the bottom lands. With these three questions in mind, the exploration was undertaken. It was not an easy thing to do, as the gorges were long and the bluffs were steep, but it was accomplished by the aid of a guide who knew the location of all the groups. We take up the groups or lines of mounds on the bluffs in their order, and call attention to the map of these different mounds as well as the topography of the country in which they were fonnd. We give the names of the people who owned the land, and call the groups by the name of the place. (1) The group on the Kendall place. This is composed of a series of long mounds and effigies which run from the edge of the bluff, overlooking the village of Wyalusing, out across land belonging to Mr. Glenn, Sec. 31, to land belonging to Mr. Kendall, on Sec. 32. This group or line of mounds overlooked the gorges on either side, and extended out to the level plateau at the head of the gorges. The line was composed mainly of long mounds, but the effigies were situated at either end of the line, the effigy of a squirrel being at the west end of the line on the edge of the bluff, and three effigies at the east end of the line; a moose, wild cat, and bear. The squirrel was a very unique and interesting effigy, representing the animal as in the attitude of running; the wild-cat was of the ordinary shape, but the moose was the most interesting of all. It was situated on the edge of the bluff overlooking a deep gorge, south of it, and commanding a view of other effigies on the other side of the gorge. (See map 1, the works in Grant Co., also Figs. 4 and 5.) The attitude of the moose was very natural.

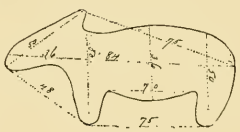


Fig. 4.

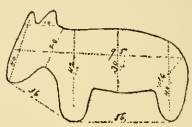


Fig. 5.

We call attention to the different effigies found in these groups, as the answers to questions asked will be found in them. It will be noticed that there are no elephant effigies in any of the groups. The effigies as discovered are as follows: (1) The squirrel on the bluff overlooking Wyalusing, map 2, Section 31. (2) The moose, Fig. 4, situated at the head of the gorge on the Kendall place, Section 32. (3 and 4) The bear and the wild-cat situated in the same group. (5) Raccoon on the Darby place, Fig. 5, Section 31. (6) The buffaloes on the Glenn place, Section 30. (7 and 8) A group of bear and three deer on the Locke place, Section 17. See Fig. 6. (9) Two buffaloes on Section 18, Figs. 7 and 10. A group of turtles on the Scnee place, Section 22. These were just such effigies as are common throughout

the state, though the attitude of the squirrel and buffalo and stag or deer were quite unique and interesting. They represent the animals which formerly abounded here. We cannot resist the impression that they represented the animals which were hunted and for which the mounds were erected as observatories. They possibly may have been the "dream gods" or "dream totems," or they may have been "game gods" or "game totems," both signifying the same thing to the superstitious hunters. There was nothing which had any resemblance to the elephant or could convey the idea that the elephant or mastodon was hunted or even known by this people.

The locality which was next examined was north of the Wisconsin river, in Crawford county. This is a region which has been explored by the assistants of the Ethnological Bureau, and we need not dwell upon it in detail. It will be sufficient to say that an interesting discovery was the result of the exploration by the writer. It was found to be the residence of a clan, the swallow being the totem of the clan. We speak of this because it is important, as throwing light on the so-called elephant effigy. The point in mind is this: The swallow which was everywhere discoverable in all the groups visited in Crawford county, shows that this was a totem of this region; and the probability is that the buffalo, which is the most num-

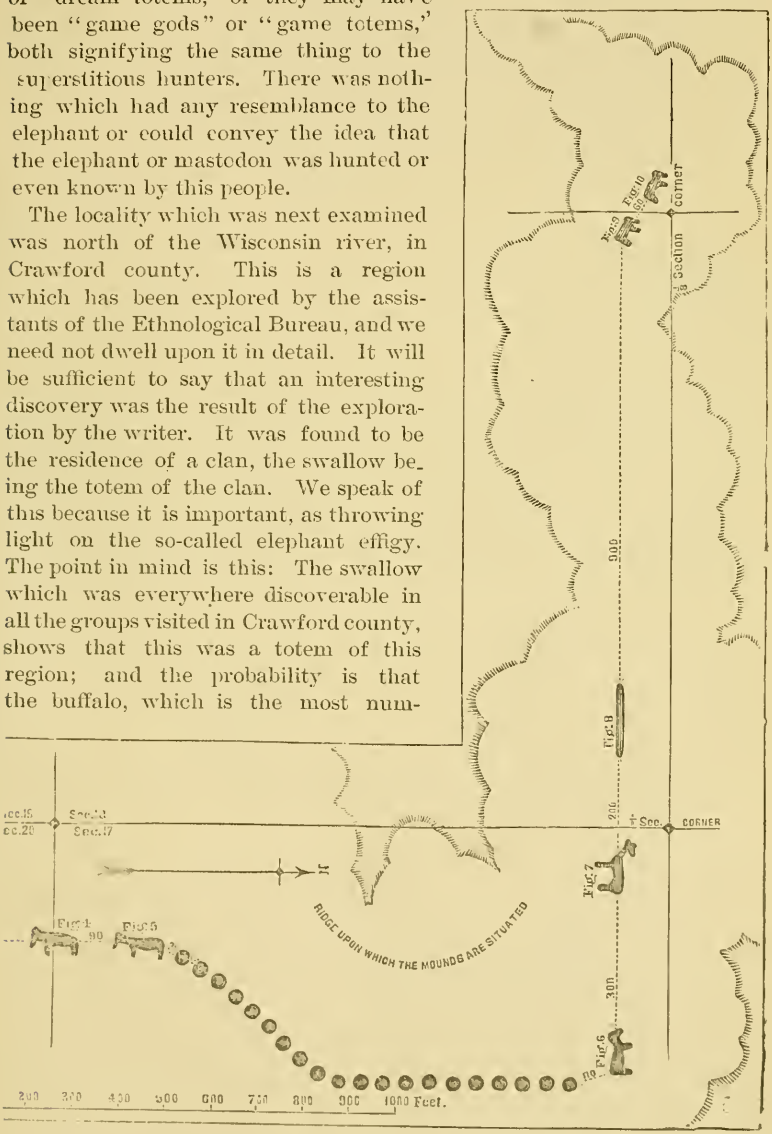


Fig. 6.

erous and prominent effigy in Grant county, was the totem of that region. If this is so, then we have an additional reason to believe that the so-called elephant effigy was nothing more nor less than a buffalo, and represented the totem of the region. We have this to contend with, however,—it was maintained by Dr. J. W. Phene, that he discovered in Campbell coolie, three miles north of Prairie du Chien, the effigy of a camel, and that the camel and elephant were associated in the mound-builders' art. The search was in part for this camel effigy, and in part to ascertain whether the theory of game drives, dream gods, and clan totems, could be carried out by the facts. The result was that the clan totem was ascertained and the theory of the game drive was rendered even more probable.

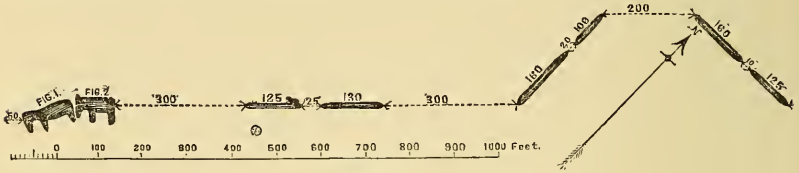
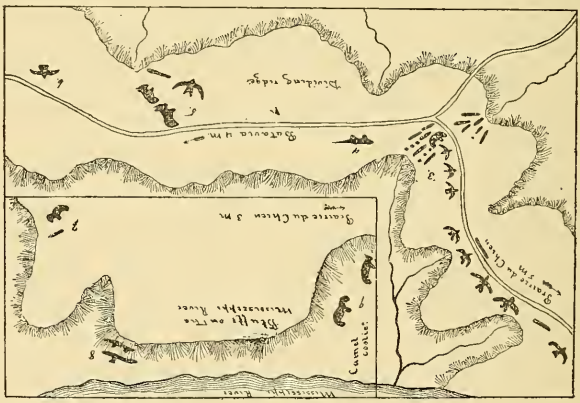


Fig. 7.

We shall illustrate the points. There are seven or eight groups on the bluffs adjoining Prairie du Chien extending along the road from Prairie du Chien to Batavia. In all these groups the swallow is most prominent. In one group, which was composed in part of long mounds, round mounds and effigies, the swallow was associated with the buffalo. (Map No. 2). In another group it is associated with two effigies of bears. (Map 2, No. 5. In a third, situated near the village of Batavia, it is isolated, and yet other effigies



Map 2.

may have been at one time near it. The groups were all situated on a ridge, but at points where the ridge was the narrowest, and where the impression was that the different kinds of game made their way across the ridge from the Mississippi river to the Kickapoo. In passing down to the val-

ley of the Mississippi other effigies were discovered. Two wolves on the side of the bluff, five miles north of Prairie du Chien (Map 2, No. 9), on the Brush place, and two effigies nearly obliterated, on the Dousman place.

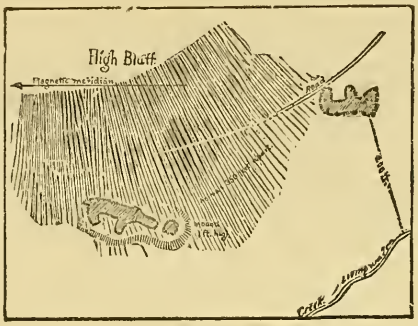


Fig. 8.

One of these we took to be the effigy of the camel, concerning which Dr. Phene and Mr. L. H. Lewis, had spoken, but we could discover no resemblance to that animal. The hasty exploration of all these groups was made in company with Dr. Cyrus Thomas, of the Ethnological Bureau, Washington, D. C., and two of his assistants. Their attention was called to the location of the groups and the theory of the game drives seemed to commend itself as a good explanation of the reasons for their erection. On the way back the party passed a group of large conical mounds, situated on the bottom lands, near the Courliss Bayou. Dr. Cyrus Thomas advanced a theory in reference to these, which seemed very plausible. It was that the mounds were made large and flat so that they could be places of refuge in times of high water. These mounds were arranged in a large circle enclosing an area of about twenty or thirty acres. The impression made upon the writer was, that it was a village site, possibly the site of the village of the very people whose game drives had been discovered upon the hill-tops. The gorges and roadways from the bottom lands to the bluffs and the summit of the ridges, seemed to concentrate near this point. Other groups of large mounds, were, however, visited subsequently, and one of them was found to have an effigy near it. It is probable that several villages existed on this prairie at different times. Which one belonged to the effigy-builders is uncertain.

The discovery of the clan totem was subsequent to this. At a point, three miles south of Prairie du Chien, there is an effigy of a swallow (Fig. 9) situated on the edge of the bluff and overlooking the Wisconsin river. The swallow has its wings spread, but the peculiarity of the effigy is that where the wings are spread to the widest fan, the bluff itself assumes the shape of the wing. Where the body is, the ridge is sharp and narrow, so sharp and narrow that the head and tail of the bird are built out from the sides of the ridge, making it seem as if the body were dropped down below the wings.

It was a singular freak for the people to have erected the effigy in such a place! but no doubt the shape of the bluff or rocky spur suggested the effigy. The clan totem found its embediment in the rock, or at least it was so imagined to be by the builders.

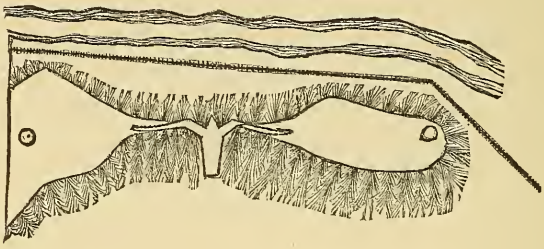


Fig. 9.

Confirmatory of this theory of the clan totem was a discovery made a few days after on the Kickapoo river. At the mouth of this river near the village of Wazeka, there is a group of long mounds and effigies, one of them the effigy of a weasel. Five miles north of Wazeka two other effigies were discovered, both of them swallows. One of these was situated on the top of a very high hill, which overlooked the valley of the Kickapoo and which commanded a view of nearly all of the groups which were previously visited, especially those on the summit of the ridges near the village of Batavia or Eastman. It was a lone swallow and seemed to mark the border line of the swallow clan. The other effigy was situated in a very retired and lonely spot, down near the the water's edge at a bend of the river and hidden away among the surrounding hills. This also was a lone bird. Its wings stretched from bank to bank across the bend of the river, and it covered the bottom-land. The impression formed from these two effigies was that the Kickapoo river was occupied by the swallow clan.

In all these groups which were situated north of the Wisconsin river there were no effigies which resembled in any way an elephant. There were effigies of bear, buffalo, wolves, birds and weasels, but the most numerous and common was this effigy of the swallow. This completes the report of the survey of the effigies in the vicinity of the so-called elephant mound of Grant county. There were, however, about this time various reports published concerning the discovery of elephant effigies in other parts of Wisconsin, and the writer took pains to visit these localities.

The following facts are presented as supplementary to this description of the survey. The place which was visited by the writer to ascertain the facts about a rumored elephant effigy was in Green Lake county, not far from the city of Ripon. It should be said the discussion about elephant pipes which was conducted between Mr. Chas. E. Putnam, Esq., President of the Davenport Academy of Science, and Mr. Henry W. Henshaw, of the Ethnological Bureau, during the year 1885, gave additional interest to the

survey of the effigy mounds and led many of the archæologists, to notice every report of the discovery of new elephant effigies. When, therefore, Mr. Theodore F. Wise, who was at the time publishing a monthly paper, called "The Young Mineralogist and Antiquarian," made the announcement that he had discovered an elephant effigy in the vicinity of Green Lake county, it seemed desirable to the writer that the place should be visited and the facts about the effigy be ascertained. The extension of the survey and a report of it will therefore be excusable. The trip resulted in some very interesting discoveries, but in the refutation of everything which was announced by Mr. Wise in reference to the effigy. The neighborhood of Green Lake is very interesting on account of the number and variety of its effigies. Here on the west side of the lake, situated on the summit of the bluffs and overlooking the water, the writer discovered many beautiful effigies a large majority of them being in the shape of squirrels. The squirrels were in every conceivable attitude, some of them of large size.

On the south end of the lake a group was discovered which contained the effigies of two bears and a deer in the attitude of running. There were also various groups of effigies on the southeast side of the lake. Some of these were birds, some panthers and a few turtles, but many of them were squirrels. (See Fig. 10.) The impression formed by the survey was that here was a clan residence, and that the reason for the erecting of these effigies on the various bluffs, was because the totem of the clan was that of the squirrel. The trip was extended to the shores of Lake Puckaway. Here on the south side of the lake, there are many mounds and effigies. One long row of mounds was followed for the distance of three miles; the row was situated on the edge of the bluff overlooking the lake, and consisted of long mounds, round mounds and various effigies, among which were the bear, and a fox represented as running with his head turned around and looking behind him, a very interesting effigy. A number of groups were discovered also upon the north side of the lake, one of them near the Chicago club-house. This was also in the shape of a squirrel, but a squirrel in a peculiar attitude. There were no effigies resembling the elephant, anywhere on either of the lakes. A gentleman who attended the writer in his explorations at Lake Puckaway (Mr. A. Aldrich, of Green Lake) gave information in reference to the so-called elephant effigy, and volunteered to be a guide to the spot. Accordingly, on the return trip, we went in search of the effigy, and in a field which had been plowed for many years, discovered a number of round mounds, and one that looked as if it might have been an effigy at one time, but it was so far obliterated that no shape whatever could be made out. This was at Dautz Tavern, half way between Green Lake and Lake Puckaway. Mr. Aldrich informed the writer that he was with Mr. Theodore S. Wise when he examined this mound, and that at that time it was in the same condition that it was when we visited it. The resemblance to an elephant was wrought out of the imagination of Mr. Wise, but had no existence. In fact it was im-

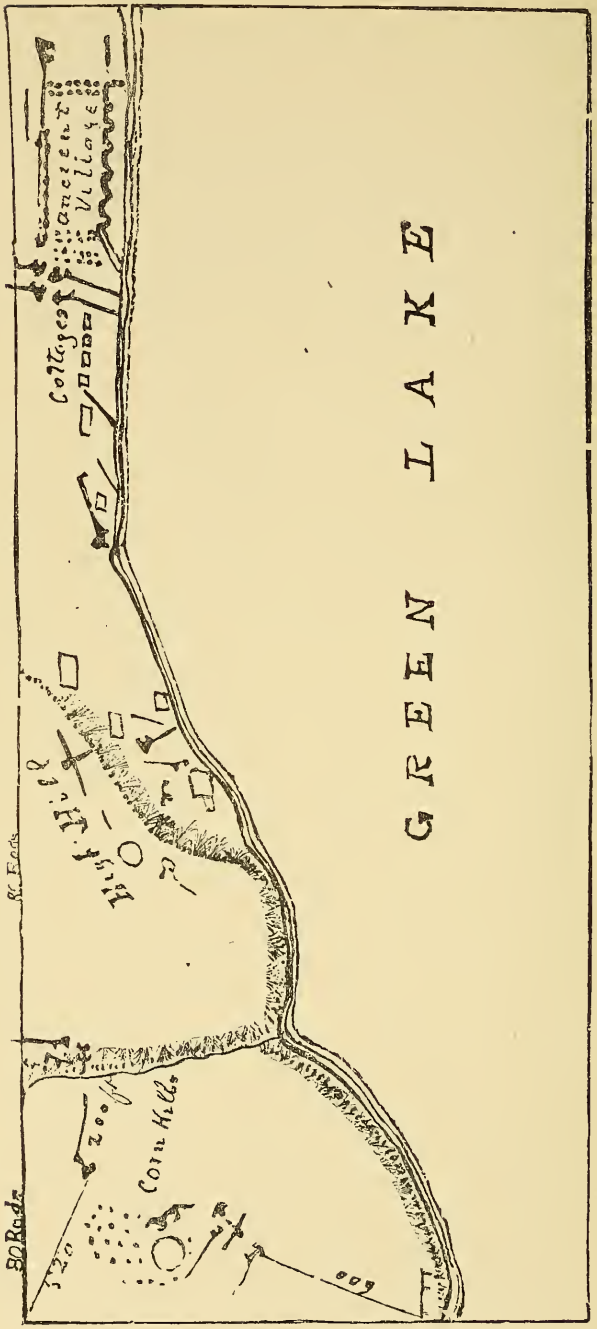

GREEN LAKE
Cottages
Ancient Village
High Hill
Corn Hills
80 Rods
200
520
600

Fig. 10.

possible to trace a single outline that would give the idea that it was an elephant effigy. This finished the search, for it was evident that the effect of the discussion was to create these imaginary figures, and it did not seem worth while to follow up uncertainties. The theory in reference to the clan emblem was confirmed, and the impression was made all the stronger that the effigies of Wisconsin were imitations of the animals which were once common in the region, and that no extinct animal is to be found represented by them.

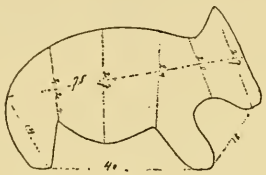


Fig. 11.

A few words more in regard to the effigies, which might be easily mistaken for the elephant. There are two effigies at Merrill Spring, near Madison (see Fig. 11), which have been by some supposed to represent elephants. They are probably effigies of buffalo. They are placed around a large conical burial mound, or lookout station, in the midst of a group which was designed to guard the camping place at the spring. There is also an effigy on Peck's place near the city of Beloit (see Fig. 12),

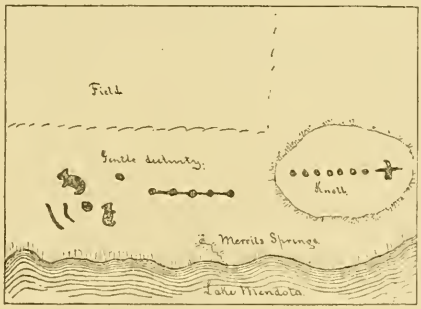


Fig. 12.

which at first sight resembles an elephant. It has the sloping rump and large, heavy body of the elephant, but lacks the proboscis. There is a projection above the head which is probably designed to represent horns. This is in the midst of a buffalo game drive, and represents the dream god, or game god, or fetish, of the hunters. There was formerly a large effigy on the Downe place, east of Beaver Dam. It is nearly obliterated now, but formerly represented some four-footed animal, such as bear, buffalo or moose. It might have been mistaken for an elephant. There is a mound which Mr. T. H. Lewis discovered on the bluffs on the west side of

the Mississippi river, opposite Prairie du Chien, which he says "resembles an elephant." It is probably a buffalo. Other mounds might be mentioned, and among them the group which was one of the earliest discovered in the state, namely, the group described by Mr. S. Taylor, and situated near Blue Mound. (See Figs. 13 and 14). One of these resembles the figure which

Fig. 13.

we have drawn out of the so called elephant effigy, and we therefore give it as a specimen. Our conclusion after all this exploration is that there are no

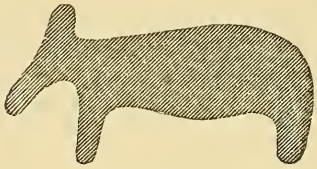


Fig. 14.

elephant effigies in the state, and that the so-called elephant mound was designed to represent either the bear, the wild-cat, the buffalo, or the moose, every one of which contains the same elements of a heavy body, a large head and a protruding snout, and any one of which might might be made to represent an elephant if we would cut off certain parts of the head, and add to other parts.

SPIDERS OF THE SUB-FAMILY LYSSOMANÆ.

BY

G. W. AND E. G. PECKHAM AND WM. H. WHEELER.

INTRODUCTION.*

Up to the present time there have been formed in the sub-family Lyssomanæ, six genera, in the following order of time:

1844. Lyssomanes Hentz.
1869. Asamonea Cambridge.
1872. Jelskia Taczanowski.
1877. Evenus † Simon, Athamas Cambridge.
1885. Simonella Peckham.

Some time ago M. Eugén Simon, with great generosity, placed a number of his unpublished species at our disposal; we have also an undescribed species of Lyssomanes from a collection of Attidæ belonging to the Berlin Museum, which was loaned to us through the courtesy of Dr. Ferd. Karsch; these additions to our own collections have enabled us to add seventeen new species to the thirteen already known in this sub-family.

We wish to express our gratitude to Dr. L. Taczanowski for specimens of all of his species of *Jelskia*, and to to the Rev. O. P. Cambridge for a specimen of *Athamas whitmeei*.

We have endeavored to separate the species into natural groups and to define the groups as closely as possible. The genus *Jelskia* we have included as a sub-genus under *Lyssomanes*, giving the new sub-generic name *Maroussa* to the other species of the genus. The sub-divisions of *Maroussa* and *Jelskia* are merely for practical convenience.

It seems probable that many of the spiders of the Lyssomanii group are adorned, in life, with delicate and brilliant colors which disappear in alcoholic specimens. This we know to be the case with *Lyssomanes viridis* which is in reality of a tender grass-green color but which appears in collections to be of the light yellowish tint which is common to many related species as known to us. The only way to define spiders of this group satisfactorily is by their anatomical proportions and by their epigynes and palpi, which should always be referred to in determining species.

Our measurements have been made in accordance with the following rules:

To determine the length of the cephalothorax, measure from the anterior edge of the eyes of the second row to the posterior edge of the thorax.

To determine the length of the cephalic part (or of the quadrangle of

* The plates for this article were contributed by the authors.

† Afterwards changed to Epeus Peckham.

eyes), measure from the anterior edge of the eyes of the second row to the posterior edge of the eyes of the fourth row.

Where the expression "width of the quadrangle of the eyes" is used, the greatest width is always meant.

The position of the eyes of the third row is determined by measuring from the posterior edge of the eyes of the second, and the anterior edge of the eyes of the fourth row.

DISTRIBUTION OF THE LYSSOMANII.

The distribution of the species of Lyssomanii presents some interesting facts. The genus *Asamonea* falls very naturally into two divisions. The two species constituting the first division, *A. gracilis* and *A. flava*, are confined to South America; the four species forming the second division are restricted to Southern Asia and South Africa. At first sight it would seem well to have formed two genera, allotting to each the Asemoneæ of a hemisphere. Careful study of the species, however, has convinced us that such a proceeding would have been unadvisable, as the morphological characteristics of either group could not be raised to generic importance.

All ten species of Lyssomanes belonging to the sub-genus *Jelskia* are confined to Central and South America. The sub-genus *Maroussa* resembles *Asamonea* in that its species are divided between two hemispheres. One species only, *M. modestus*, is reported from the old world, occurring in Madagascar; of the remaining seven new world forms, five occur in South America, one in the island of San Domingo and one in the southern states of the Union.

Regarded as an isolated fact, this distribution of the members of a genus over the tropics of two hemispheres seems anomalous. But analogous cases in the distribution of other organisms are by no means rare. Among plants especially such cases are common. Among animals we may cite the case mentioned by Wallace of the four species of *Megacephala* (a genus of the Cicindelidæ, or tiger beetle family) two of which occur in Africa and two in South America. In like manner four species of another genus, *Peridexia*, of the same family, are equally divided between South America and Madagascar. Then again when we consider the great antiquity of the existing genera of spiders, we can see nothing difficult of explanation in the wide and discontinuous distribution of the Asamoneæ and Maroussæ. We have only another instance confirmatory of the truth of Wallace's remarks that "Insects exhibit in a very marked degree in their actual distribution the influence both of very ancient and very modern conditions of the earth's surface. The effects of the ancient geographical features of the earth are to be traced in the large number of cases of discontinuous and widely scattered groups which we meet with in almost every family, and which, to some extent, obscure the broader features of distribution due to the period during which the barriers which divide the primary regions have continued to exist."*

* A. R. Wallace, Distribution of Animals, Vol. I, p. 503.

The absence of Lyssomanii in Europe and northern Africa would seem to indicate that the ancestors of this group of spiders during the miocene tertiary ranged through northern Asia and what is now British America. The connection existing between Alaska and northeastern Asia, as shown by the flora of that epoch, would present no obstacle to a group of spiders originating on one of the continents passing over into the other. The advent of the Glacial Epoch, we may suppose, drove the Lyssomanii, which even then had separated into two genera corresponding to our Asamonea and Lyssomanes, members of both of which occurred on either continent, southward, on the one hand through Asia and on the other hand through North America. The distance which the species are driven is considerable, as none seem to have remained on what is now the Asiatic Continent, but all passed over to Ceylon and the neighboring Madagascar, whence some probably wandered to South Africa. Similarly in North America the species were forced southward to Central America, whence some migrated to South America. Here the conditions were most favorable to the development of species as the majority of existing forms is reported from this continent. It is still doubtful whether or not the single species in the island of San Domingo and the single species in the southern United States are to be regarded as forms which were left behind in the wholesale migration of the group or whether they are species which have migrated northward from South America since the close of the Glacial Epoch. We incline to the latter supposition, since it is more probable that a limited number of species would undertake a northward migration than that such a limited number would be spared under conditions which were fatal to the existence of a whole group in the eastern hemisphere. It is, of course, also possible that the Central American species have migrated northward since the close of the Glacial Epoch.

It is interesting to note a somewhat similar distribution in another family of spiders, the Archaeidæ. This family includes four genera; one of these is extinct, and is represented by fossils in the Baltic amber of the Tertiary period; of the three genera that are represented by living species; one is found in Madagascar, one in western Africa, and one in the southern part of South America.*

FAMILY ATTIDÆ.

SUB-FAMILY LYSSOMANÆ.

Eyes in four transverse rows.

Group I. Lyssomanii. Cephalothorax low or moderately high, rather elongated, longer than wide.

Group II. Athamii. Cephalothorax high, short, quadrate.

Group III. Simonellii. Cephalothorax nodose; spiders ant-like in form.

* E. Simon, Ann. Mus. Civ. di Storia Naturale di Genova, V. XX, 1884.

GROUP I. LYSSOMANII.

Quadrangle of eyes never more than one-third wider than long ..... *Lyssomanes.*
Quadrangle of eyes at least twice as wide as long..... *Asamonea.*

GENUS LYSSOMANES HENTZ.

Cephalothorax moderately high, sloping downward behind and on the sides from the caput; about one-third longer than wide. General form oval. Caput occupying one-half or nearly one-half of cephalothorax.

Eyes arranged in four transverse rows of two each. Eyes of first row close together, from two to three times as large as those of second row, occupying the entire face. Second row just behind first and about as wide (sometimes a little wider or narrower). Third row composed of two very small eyes, plainly nearer the second than the fourth row; narrower than second and wider than fourth row. Eyes of fourth row about as large as those of the second and nearer together; quadrangle formed by second and fourth rows as wide as long or from one-fourth to one-third wider.

Sternum somewhat heart shaped; length and width about equal.

Coxæ separated by the width of the labium and part or all of the maxillæ.

Maxillæ slightly enlarged at extremities.

Labium about as wide as long or a little longer than wide.

Abdomen long, slender, tapering, spinnerets short.

Legs usually long and slender. Relative length variable. Long and slender femoral, tibial, metatarsal and usually patellary spines on the four pairs.

Sub-genus *Maroussa.** Second row of eyes always wider than first. Eyes of second row frequently only about one-third as large as those of first.

Sub-genus *Jelskia.* Second row of eyes not wider than first (equally wide or a little narrower). Eyes of second row relatively larger than in *Maroussa* and often placed directly above those of first row, looking forward.

SUB-GENUS MAROUSSA.†

A. Quadrangle of eyes not more than one-fourth wider than long.

Femur of the first as long as femur and patella of the second; metatarsus of the first bent..... *antillanus.* (San Domingo).

Femur of the first scarcely longer than femur of the second; metatarsus of the first not bent..... *unicolor.* (Peru).

*Russian proper name.

†All the species of the sub-genus *Maroussa* have the leg formula 1 2 3 4, excepting *modestus*, Madagascar (4 1 3 2), and *antillanus*, San Domingo (1 4 3 2); while in the sub-genus *Jelskia* the formula 1 2 3 4 occurs in only three species, *amazonicus*, *nigropictus* and *landus*.

O

LYSSOMANES ANTILLANUS N. Sp.

Plate XI, figure 1.

♂. Length of cephalothorax 2.4 mm; of abdomen, 4 mm.

Legs 12.5, 9.5, 8.5, 7.4.

Cephalic and thoracic parts equally long. Quadrangle of eyes one-fourth wider than long. Eyes of first row nearly three times as large as those of the second. Clypeus one-fifth as high as anterior eyes. Falces rounded, horizontal, diverging, four or five times as long as face; fang as long as falx. Maxillæ rounded and a little enlarged at their extremities. Labium a little longer than wide, a little narrower, and blunt at the tip, one-half as long as maxillæ. Legs 1, 2, 3, 4; femur of the first as long as femur with patella of the second; metatarsus of the first elongated and curved.

Coloration (dry): Upper surface of cephalothorax light-yellowish brown, with some bright red hairs on the eye region, and a dark brown central band from the fourth row of eyes to the posterior margin. Clypeus bright red with a whitish line above the insertion of the falces. Abdomen above dark brown with a white band around base and sides. Falces dark brown, fang black. Legs, palpi, mouthparts and coxæ light brown. Sternum and venter drab, with short white hairs.

Habitat: San Domingo.

From the collection of M. Simon.

LYSSOMANES UNICOLOR Tacz. 1874.

Plate XI, figure 2; plate XII, figure 21.

Jelskia unicolor Tacz. 1874. Les Aranéides de la Guyane Française Horæ Soc. Ent. Ross., T. VIII, p. 131,

" " " 1879. Les Aranéides du Pérou, Bull de la Soc. Imp. des. Nat. de Moscou. T. LIII, 1878, No. 4, p. 373.

♂. Length of cephalothorax 2.7 mm; of abdomen 4.2 mm.

Legs 12, 10.9, 10.8, 10.7.

♀. Length of cephalothorax 3 mm; of abdomen 5.2 mm.

Legs 12, 11, 10.5, 10.5.

Cephalic and thoracic parts equally long. Quadrangle of eyes scarcely one-fourth wider than long. Eyes of first row but little more than twice as large as those of second. Second row wider in ♂ than in ♀, a little wider than the first row in both sexes. Clypeus about one-third as high as anterior eyes. Falces weak, vertical, parallel, about as long as face; fang weak. Maxillæ rounded and a little enlarged at their extremeties. Labium about as wide as long, blunt,

(♂) one-half, (♀) a little more than one-half as long as maxillæ. Coxæ of the first not so widely separated as usual, *i. e.*, by scarcely more than the width of the labium. Legs 1, 2, 3, 4; femur of the first but little longer than femur of the second; metatarsus of the first not curved.

Coloration (dry): ♂. Upper surface of cephalothorax pale yellow; eye-region nearly covered with bright red hairs; white hairs on the clypeus, in circles around the anterior eyes, and in patches outside the second and third rows of eyes. Upper surface of abdomen pale yellow with two divergent brown bands from base to apex, which are enlarged at three points to form as many pairs of opposed dots, one pair at each end, and one in the middle. Legs pale yellow with black spines and tips and dark brown bands at the joints. Palpus pale; bulb brown with pale tarsus projecting beyond. Falces and under surface pale pellow.

The same description answers for the female, excepting that the bands and dots on the abdomen are indistinct, and that there are no brown bands on the legs.

Habitat: French Guiana, Peru.

By the relatively larger eyes of the second row, and the relatively greater length of the quadrangle of the eyes this species approaches the sub-genus *Jelskia*.

B. Quadrangle of eyes one-third wider than long.

MALES.

1	Femur of the first as long as femur and patella of the second..	*viridis.* (South United States).
	Femur of the first not so long as femur and patella of the second	2
2	Tarsus of palpus less than twice as long as tibia.....	*bi-tæniatus* (Venezuela).
	Tarsus of palpus more than twice as long as tibia	3
3	No fringe of hairs on tibia of the first.....	*placidus.* (Mexico).
	Tibia of the first with fringe of hairs.....	4
4	Tibia of the first with fringe of hairs on proximal half of upper side and on distal half of under side; tibia of the second with fringe of hairs throughout its length on under side.....	*miniaceus.* (Rio Janeiro).
	Tibia of the first with fringe of hairs on under side nearly throughout its length; no fringe on tibia of the second.....	*austerus* (Rio Janeiro).

FEMALES.

1	Legs 4 1 3 2.....	*modestus.* (Madagascar).
	Legs 1 2 3 4.....	2
2	Eyes of first row three times as large as those of second; falces twice as long as face, moderately stout.....	*viridis.* (South United States).
	Eyes of first row only twice as large as those of second; falces as long as face, weak	*tristis.* (Brazil).

LYSSOMANES VIRIDIS Walck. 1837.

Plate XI, figure 3. Plate XII, figures 6, 6a, 6b.

Altis viridis Walck. 1837. Hist. Nat. des. Insectes. T. I, p. 469.
Lyssomanes viridis Hentz. 1844. Jour. Bost. Soc. Nat. Hist., IV., pp. 386–396.
" " " 1875. Occ. Pap. Bost. Soc. Nat. Hist., II, Spiders of U. S., p. 48.

♂. Length of cephalothorax 2.5 mm; of abdomen 4.5 mm.
Legs 12, 9.5, 8.5, 8.2. Falces 2.3 mm.
♀. Length of cephalothorax 3 mm; of abdomen 5.2 mm.
Legs 10, 9, 8, 7.8. Falces 1 mm.

Cephalic part not quite so long as thoracic. Quadrangle of eyes one-third wider than long. Eyes of first row three times as large as those of second row. Clypeus one-fourth as high as anterior eyes. Falces (♂) horizontal, diverging, rounded, four times as long as face; on the distal end of each falx, on the inner edge, are two stout projections; fang as long as falx, curved. Falces (♀) rather stout, nearly vertical, twice as long as face; fang one-half as long as falx. Maxillæ rounded and a little enlarged at their extremities. Labium a little longer than wide, more than one-half as long as maxillæ, blunt; in ♂ narrow at the base. Legs 1, 2, 3, 4. Femur of the first (♂) quite, (♀) nearly equal to femur with patella of the second. Metatarsus of the first (♂) bent, with fine fringe of hairs at distal end. Spines rather long.

Coloration (under alcohol): Upper surface of cephalothorax and falces light yellow (♂) with tinge of red; a short dark median longitudinal line on anterior thoracic part. Sternum, coxæ, mouthparts and upper and under surface of abdomen pale yellow. Legs pale with slightly darker spines and black tips, (♂) tibia of the first darker toward extremity with some short dark hairs; matatarsus of the first brown at distal end with fringe of short brown hairs.

Habitat: Southern United States.

Hentz describes this species as follows: "Tender grass-green; cephalothorax with some orange-colored hairs near the eyes, and a little black line on the disk; abdomen with six or eight black dots, sometimes wanting." The green color evidently fades to a light yellow in alcohol. Hentz probably never had a mature male, as he makes no reference to the long horizontal falces.

LYSSOMANES BI-TÆNIATUS N. Sp.

Plate XI, figure 4.

♂. Length of cephalothorax 2.5 mm; of abdomen 4 mm.

Legs 11.5, 9.4, 9, 8.8. Falces 1.5 mm.

Cephalic and thoracic parts equally long. Quadrangle of eyes nearly one-third wider than long. Eyes of first row about three times as large as those of second row. Clypeus one-fifth as high as anterior eyes. Falces horizontal, diverging, three times as long as face; fang bent, as long as falx. On the front face of each falx, just above the insertion of the fang, are seven or eight stout hairs which form a triangle with the apex up. Maxillæ rounded and a little enlarged at their extremities. Labium as wide as long, one-half as long as maxillæ, truncated. Legs 1, 2, 3, 4. Femur of the first nearly as long as femur with patella of the second. Metatarsus of the first elongated, bent, with a fringe of hairs occupying distal third. Palpus with femur elongated, and patella plainly shorter than tibia. Tibia with a row of stout hairs on upper and outer side of distal half.

Coloration (under alcohol): Upper surface of cephalothorax pale yellow with a dark line around lower margin, and a central longitudinal dark line on thoracic part. Upper surface of abdomen pale yellow with two parallel longitudinal brown bands throughout its length, on which are three pairs of spots, formed by enlargements of the bands. Falces pale yellow, with an oblique band of darker reddish yellow arising at the proximal end, above, and passing downward and inward to the inner side of the insertion of the fang. Legs pale yellow with dark bands at joints, brown spines, and black tips. Palpus and entire under surface, light yellow.

Habitat: Venezuela. (Caracas).

From the collection of M. Simon.

LYSSOMANES PLACIDUS N. Sp.

Plate XI, figure 5.

♂. Length of cephalothorax 2.8 mm; of abdomen 4 mm.

Legs 12, 9.3, 9, 8.8.

Cephalic and thoracic parts equally long. Quadrangle of eyes one-third wider than long. Eyes of first row more than twice as large as those of second. Clypeus nearly one-half as high as anterior eyes. Falces weak, vertical, parallel, as long as face; fang weak. Maxillæ truncated and a little enlarged at their extremities, cut obliquely on their inner edges. Labium longer than wide, rounded, slightly more than one-half as long as maxillæ. Legs 1, 2, 3, 4; femur of the first

shorter than femur with patella of the second; metatarsus of the first long, slightly bent; tarsus of the first with fringe of hairs. The tibial and metatarsal spines are long and slender, and are arranged in inferior rows.

Coloration (dry): Upper surface of cephalothorax light brown with a dark line around the lower margin; eye-region and clypeus pale, covered with white and red hairs. Upper surface of abdomen blackish, with a white central longitudinal band extending through two-thirds of its length; this band suddenly contracts a little behind its middle point, its posterior end being thus made narrower than its anterior portion. The posterior end of the venter is blackish, the color being continuous with that of the upper surface, and extending forward in a gradually narrowing band, to about the middle; on either side of this band, and at the anterior end, the venter is white. Legs and palpi pale with dark bands and black tips, the first and second pairs of legs being darker than the third and fourth; tarsus of the first black with a fringe of black hair. Other parts all pale.

Habitat: Mexico.

LYSSOMANES MINIACEUS N. Sp.

Plate XI, figure 6.

♂. Length of cephalothorax 3 mm; of abdomen 4 mm.

Legs 10.8, 8.8, 8, 7.8.

Cephalic and thoracic parts equally long. Quadrangle of eyes one-third wider than long. Eyes of the first row twice as large as those of second. Clypeus nearly one-half as high as anterior eyes. Falces weak, nearly vertical, about as long as face; fang short. Maxillæ rounded and a very little enlarged at their extremities, excavated on their inner sides for the labium. Labium a very little longer than wide, more than one-half as long as maxillæ, widest in the middle, blunt at tip. Legs stouter than is usual in this genus, 1, 2, 3, 4. Femur of the first but little longer than femur of the second. Fringes of hair on upper and under sides of tibia of the first, on under side of tibia of the second, and on outer distal half of femur of palpus.

Coloration (dry): Upper surface of cephalothorax pale brown with a dark rim around the lower margin. Eye region covered with bright yellowish red hairs, which surround the anterior eyes. Clypeus light brown, with lower margin black. Upper surface of abdomen dark drab, with a wide, pale central band extending through half of its length; under surface dark brown with a curved, white, longitudinal band on each side. Falces light reddish. Sternum and coxæ light red, coxæ of the first, deeper in color than the others. Mouthparts brown, tipped with pale. Legs of first pair red; of second, third and fourth pairs red mingled with white, the fourth pair being almost en-

tirely white. Palpus red, excepting proximal half of femur which is pale. Tips of legs, spines and fringes of hair on legs and palpi, black.

Habitat: South America (near Rio Janiero).

From the collection of M. Simon.

LYSSOMANES AUSTERUS N. Sp.

Plate XI, figure 7. Plate XII, figure 17.

♂. Length of cephalothorax 2.7 mm., of abdomen 4.5 mm.

Legs 11.5, 9.5, 9.3, 9.3.

♀. Length of cephalothorax 2.8 mm; of abdomen 4 mm.

Legs 9, 7.8, 7.3, 6.9.

Cephalic part not quite so long as thoracic. Quadrangle of eyes one-third wider than long. Eyes of first row three times as large as those of second. Clypeus one-third as high as anterior eyes, (♂) projecting forward over the falces. Falces nearly vertical, parallel, as long as face, (♂) moderately stout, (♀) weak. Maxillæ rounded and a little enlarged at their extremities. Labium longer than wide, rounded, narrowing slightly toward its base, and a little more than one-half as long as the maxillæ. Coxæ of the first separated (♀) by a little more than width of labium, (♂) more widely. Legs 1, 2, 3, 4; femur of the first nearly as long as femur with patella of the second; tibia of the first with a fringe of stout hairs.

Coloration (dry): ♂. Upper surface of cephalothorax light brown, pale on the anterior side; eye-region with bright red hairs. Abdomen blackish with a pale central longitudinal band above, and two white longitudinal lines on the venter. Falces brown. Sternum and coxæ pale. Mouthparts dark tipped with white. First and second pairs of legs with first three joints dark brown and the others pale; third and fourth pairs dark brown with pale rings; tarsi tipped with black. Palpus brown with proximal end of femur pale. (♀) light yellow; eye region covered with bright red hairs. Spines and tips of legs black.

Habitat: South America (near Rio Janeiro.)

From the collection of M. Simon.

LYSSOMANES MODESTUS N. Sp.

Plate XII, figure 10.

♀. Length of cepalothorax 2 mm; of abdomen 3.3 mm.

Legs 7, 6.5, 6.8, 8.

Cephalic and thoracic parts equally long. Quadrangle of eyes one-third wider than long. Eyes of first row a little more than twice as large as those of second. Clypeus one-half as high as anterior eyes. Falces

weak, vertical, parallel, scarcely as long as face; fang weak. Maxillæ rounded and a little enlarged at their extremities. Labium as wide as long, rounded, almost one-half as long as maxillæ. Coxæ of the first separated by but little more than the width of the labium. Legs 4, $\overline{1, 3}$, 2; femur of the first scarcely longer than femur of the second.

Coloration (dry): Upper surface of cephalothorax, light yellow; eye-region surrounded above by a band of bright-red hairs covered in the middle with white hairs. Clypeus with thick white hairs. Abdomen above light brown or yellow, with silvery white hairs; two parallel longitudinal bands of red hairs extend throughout its length, and these are connected by transverse bands of red hairs in three places, at the anterior and posterior ends, and in the middle. Legs light yellow with brown spines and black tips. Other parts all light yellow.

Most of our specimens have all the hair rubbed off from the abdomen, which then presents a plain light colored surface with a few dark dots.

Habitat: Madagascar.

LYSSOMANES TRISTIS N. Sp.

Plate XII, figure 12.

♀. Length of cephalothorax 2.5 mm; of abdomen 5 mm.

Legs 8.5, 7.4, 7, 5.

Cephalic part not quite so long as thoracic. Quadrangle of eyes one-third wider than long. Eyes of first row twice as large as those of second. Clypeus a little less than one-half as high as anterior eyes. Falces weak, vertical, about as long as face; fang short. Maxillæ rounded, and a little enlarged at their extremities. excavated on their inner sides for the labium. Labium about as wide as long, blunt, and narrowing a little at the tip, and a little more than one-half as long as maxillæ. Legs 1, $\overline{2, 3}$, 4; femur of the first shorter than femur with patella of the second.

Coloration (dry): Upper surface of cephalothorax yellowish-brown; eye-region and clypeus covered with snowy white hairs. Abdomen, above and beneath, very light brown, probably covered with white hairs, which in the specimens which we have examined are almost entirely rubbed off. Legs pale, darkening somewhat toward the proximal ends, with brown tips, and light colored spines. Other parts all pale.

Habitat: Brazil.

From the Berlin collection, through the courtesy of Dr. Ferd. Karsch.

Sub-Genus Jelskia.

A. Quadrangle of eyes as long as wide, or barely wider than long.

MALES.

1	Tarsus of palpus five times as long as tibia	*tenuis.* (Brazil).
	Tarsus of palpus only twice as long as tibia	2
2	Falces very long (3 mm); fang as long as falx	*jemineus.* (South America).
	Falces short; fang plainly shorter than falx	*nigropictus.* (Amazon).

FEMALES.

3	Metatarsus of the first elongated and bent	*jemineus.* (South America).
	Metatarsus of the first neither elongated nor bent	*parallelus.* (South America).

LYSSOMANES TENUIS N. Sp.

Plate XI, figure 8.

♂. Length of cephalothorax 2 mm; of abdomen 2.9.

Legs 13, 9, 8, 10.

Cephalic part as long as thoracic. Quadrangle of eyes as long as wide. Eyes of first row twice as large as those of second. Second row narrower than first. Clypeus one-fifth as high as anterior eyes. Falces nearly horizontal, diverging, a little longer than face; fang as long as falx. Maxillæ rounded and slightly enlarged at their extremities, excavated for the labium. Labium as wide as long, one half as long as maxillæ, narrowing at base, blunt at extremity. Legs 1, 4, 2, 3; femur of the first longer than femur with patella of the second; femur, tibia and metatarsus of the first, much elongated. Legs all slender. Spines growing gradually weaker from first to fourth, being scarcely more than hairs on tibia and metatarsus of the fourth. Palpus with patella and tibia more than two-thirds as long as tarsus. Spines on palpus as follows: femur, two spines at distal end, one just behind these, and a fourth in the middle; patella, one long spine at distal end; tibia, one in the middle and one at distal end; tarsus, two spines, or long hairs, on dorsum of enlarged part, one placed behind the other.

Coloration (dry): Upper surface of cephalothorax, clypeus and abdomen black with thin, white hairs, the abdomen having a faintly indicated transverse band of a lighter shade behind the middle. Falces and palpi dark brown. Sternum, coxæ and mouthparts, light brown. Legs light reddish brown, with brown spines and black tips.

Habitat: South America (near Rio Janiero.)

From the collection of M. Simon.

See remarks under *Jelskia velox.*

LYSSOMANES JEMINEUS N. Sp.

Plate XI, figure 9. Plate XII, figure 14.

♂. Length of cephalothorax 2.5 mm; of abdomen 5 mm.

Legs 16.3, 12, 11.4, 11.8. Falces 3 mm.

♀. Length of cephalothorax 3 mm; of abdomen 5 mm. (Legs too badly broken to be measured.)

Cephalic part not quite so long as thoracic. Quadrangle of eyes about one-fifth wider than long. Eyes of first row three times as large as those of second. Second row slightly narrower than first. Clypeus nearly one-third as high as anterior eyes. Falces (♂) stout, horizontal, three times as long as face, diverging; fang as long as falx, with a double curve; (♀) stout, nearly vertical, about twice as long as face, bulging in front, nearly parallel; fang short. Maxillæ blunt, and a little enlarged at their extremities. Labium longer than wide, a little more than one-half as long as maxillæ, widest in the middle. Legs 1, 2, 4, 3; (♂) femur, tibia and metatarsus of the first all much elongated, metatarsus curved; a wide fringe of hairs on each side of tibia and metatarsus of the first, less marked on tibia of the second, and much less on metatarsus of the second; (♀) metatarsus of the first long, curved, without hairs, but with longer and stouter spines than ♂. (♂) Palpus with femur as long as falx; patella but little shorter than tibia; patella and tibia two-thirds as long as tarsus; a bunch of hairs on outer side of distal half of tibia; two spines at distal end of femur and one at extremity of patella.

Coloration (under alcohol): Cephalothorax, reddish yellow; cephalic part with a band of yellowish white hairs on each side below the eyes; a large bright red spot behind the eyes of the fourth row which extends forward between them; and a red spot on the outer side of each anterior eye; eyes of third row surrounded by reddish hairs. Thoracic part with a dark brown central longitudinal band extending from just behind fourth row of eyes to posterior margin. Falces reddish yellow. Mouth parts, sternum and coxæ pale yellow; abdomen above, mottled brown; sides pale yellow; venter with dark brown, median, longitudinal band. Legs pale yellow or light brown; (♂) black fringes of hair on tibiae and metatarsi of the first and second. (♂) Palpus pale yellow excepting tibia and tarsus which are brown.

Habitat: South America.

From the collection of M. Simon.

The male of this species is easily distinguished by its elongated falces, and by the double fringes of hair on the first and second pairs of legs.

LYSSOMANES NIGROPICTUS N. Sp.

Plate XI, figure 10.

♂. Length of cephalothorax 2.8 mm; of abdomen 4 mm.

Legs 12.5, 11.5, 11.3, 10.8.

Cephalic part as long as thoracic. Quadrangle of eyes scarcely wider than long. Eyes of first row twice as large as those of second row. First and second rows equally wide. Clypeus nearly one-half as high as anterior eyes. Falces weak, parallel, vertical, as long as face; fang weak. Maxillæ rounded and slightly enlarged at their extremities, excavated on their inner sides for labium. Labium longer than wide, about one-half as long as maxillæ, blunt at tip, widest in the middle, and narrowing toward both ends. Coxæ separated by but little more than width of labium. Legs 1, 2, 3, 4. Femur of the first scarcely longer than femur of the second. Palpus with patella and tibia three-fourths as long as tarsus. Spines on palpus as follows: femur, two on dorsum at distal end; patella, one long spine at extremity; tibia, one behind middle on inner side, and one at distal end; tarsus, two long spines on dorsum of enlarged part, placed side by side.

Coloration (under alcohol): Upper surface of cephalothorax with eye-region white, and the remainder very light brown; there is a black line around the lower margin and a central dark brown band from the fourth row of eyes to the posterior edge. Upper surface of abdomen white with four pairs of brown spots; the first pair is on the anterior face of the abdomen and is not plainly visible from above; the third pair is just behind the middle point of the dorsum; the fourth pair is just in front of the white spinnerets, and the two spots are connected by a brown band. Legs white with brown rings and spines and black tips. Palpus white with a dark line on each side of the femur, and having the bulb light brown, and some dark hairs at the extremity of the tarsus. Other parts all white.

Habitat: South America (Amazon).

From the collection of M. Simon:

The tarsus of the palpus of this species has an arrangement of the spines which is only duplicated in *Jelskia velox*, the palpus differing from that of this species in having no fringes of hair on the patella and tibia. It has, moreover, the first two pairs of legs more nearly equal in length than any species excepting *Jelskia robusta*, from which it is quickly distinguished by its much lighter color.

LYSSOMANES PARALLELUS. N. Sp.

Plate XII, figure 15.

♀. Length of cephalothorax 1.9; of abdomen 3 mm.

Legs 9, 7, 7, —. (Fourth leg missing.)

Cephalic part as long as thoracic. Quadrangle of eyes scarcely wider than long. Eyes of first row a little more than twice as large as those of second. Second row narrower than first. Clypeus scarcely one-fifth as high as anterior eyes. Falces moderately stout, somewhat inclined forward, diverging, as long as face. Maxillæ excavated on inner sides for labium; extremities rounded, near together, but little enlarged. Labium but little longer than wide, truncated, a little more than one-half as long as labium. Legs 1, 2, 3, —; femur of the first as long as femur with patella of the second.

Coloration (dry): Eye region covered with mixed red and white hairs; upper surface of thoracic part brown, glabrous, with a pale transverse band just behind the fourth row of eyes; sides pale excepting lower margin, which is brown. Clypeus covered with white hairs. Abdomen pale with two longitudinal brown bands originating separately at the base and meeting at the apex. Falx yellowish brown with a fringe of red hairs at extremity. Mouthparts light brown. Sternum, coxæ, and venter pale yellowish. Legs pale; first leg and femur of second with a dark line on each side; spines brown, tips black. Palpus pale excepting tarsus, which is light brown.

Habitat: South America.

From the collection of M. Simon.

B. Quadrangle of eyes from one-fifth to one-third wider than long.

MALES.

1	Tarsus of palpus five times as long as tibia	*velox.* (Brazil).
	Tarsus of palpus only twice as long as tibia	2
2	Femur of the first as long as femur and patella and one-half tibia of the second	*longipes.* (French Guiana).
	Femur of the first scarcely longer than femur of the second	3
3	Legs 1 $\overline{3\ 4}$ 2	*robustus.* (Peru).
	Legs 1 2 3 4	*amazonicus.* (Amazon).

FEMALES.

1	Eyes of first row three times as large as those of second; eyes of fourth row a little smaller than those of second	*amazonicus.* (Amazon).
	Eyes of first row only twice as large as those of second; eyes of fourth row as large as those of second	*blandus.* (Guatemala).

LYSSOMANES VELOX N. Sp.

Plate XI, figure 11.

♂. Length of cephalothorax 2.7 mm.; of abdomen 4 mm.

Legs 14, 13.2, 15, 15.5.

Cephalic part plainly shorter than thoracic. Quadrangle of eyes a little more than one-third wider than long. Eyes of first row three times as large as those of second. First and second rows equally wide. Clypeus one-fourth as high as anterior eyes. Falces weak, nearly vertical, parallel, a little longer than the face; fang weak. Maxillæ slightly enlarged beyond the middle, rather pointed, very little excavated on their inner edges. Labium a little longer than wide, one-half as long as maxillæ, a little narrower, and blunt at tip. Legs long and slender, 4, 3, 1, 2; femur of the first about as long as femur of the second. Palpus with patella and tibia one-half as long as tarsus; patella and tibia with fringe of hairs on outer edge; those on tibia pointing downward and outward, those on patella on a higher plane, and pointing forward. Spines on palpus as follows: femur, one spine at distal end, another just behind this one, and a third about in the middle of the joint; patella, one spine at distal end, in the middle; tibia, one at distal end and one in the middle on the outer edge; tarsus two long spines on the dorsum of the enlarged part, placed side by side.

Coloration (under alcohol): Inter-ocular region pale, almost white; thoracic part and sides brown, growing much darker toward lower margin. Clypeus brown with a black line above falces. Abdomen, above, with sides white, and a large white spot at anterior end which contracts behind to form a long point; dorsum occupied by a wide brown band which bifurcates in front to surround the white spot. Falces brown with white extremities. Mouthparts dark brown. Coxæ of the first brown; other coxæ, and sternum, white. Venter pale, excepting at posterior end where it is brown. Legs with upper faces of femora and tarsi pale; otherwise brown. Palpus dark brown.

Habitat: Brazil.

From the collection of M. Simon.

This species and *Jelskia tenuis* are easily distinguished from other members of this genus by their dark color and elongated legs; while *velox* is distinguished from *tenuis* by the hairs on the patella and tibia of the palpus, and by the position of the spines on the tarsus of the palpus, these being placed side by side in *velox* and one behind the other in *tenuis*.

LYSSOMANES LONGIPES Tacz. 1874.

Plate XI, figure 12.

Jelskia longipes Tacz., 1874. Les Aranèides de la Guyane française, Horae Soc. Entomol. Ross., T. VIII, p. 32–132.

♂. Length of cephalothorax 2 mm; of abdomen 3.2 mm.

Legs 12.4, 8.3, 7.7, 8.

Cephalic part as long as thoracic. Quadrangle of eyes one-fifth wider than long. Eyes of first row a little more than twice as large as those of second. Second row narrower than first. Clypeus about one fifth as high as anterior eyes. Falces very weak, vertical, parallel, as long as face; fang short. Maxillæ rounded, and a very little enlarged at their extremities, excavated on inner sides for labium. Labium as wide as long, one-half as long as maxillæ, blunt. Legs 1, 2, 4, 3; femur of the first very long, equalling femur with patella and half tibia of the second. Palpus with patella and tibia about equal in length; patella and tibia three-fourths as long as tarsus, spines on palpus as follows: Femur, two at distal end, and one in the middle of the dorsum, all short; patella, one at extremity; tibia, one long hair in the middle, and one at extremity; tarsus, one long hair on dorsum of enlarged part.

Coloration (under alcohol): Upper surface of cephalothorax deep reddish yellow, with a narrow black line around lower edge and another on the central thoracic region; eyes, as usual, on black spots. Abdomen above, with a blackish region at the extremity in front of which is a white band; the remainder of the dorsum is blackish excepting three white spots, one elongated, large, one on the anterior central part, and two smaller, which come off obliquely from the posterior corners of the first one. Spinnerets white. Ventral surface white excepting at the extremity where it is blackish. Sternum, mouthparts, and falces yellow. Legs light yellow with brownish spines and tips. Palpus pale with the bulb reddish brown.

When dry, the eye-region is seen to be covered with white hairs. The abdomen is also thinly covered with short white hairs.

Habitat: French Guiana.

From the collection of Dr. Taczanowski.

This species is distinguished by the great relative length of the first pair of legs, and especially by the elongation of the femora of that pair.

LYSSOMANES ROBUSTUS Tacz. 1879.

Plate XI, figure 13. Plate XII, figure 7.

Jelskia robusta Tacz. Les Aranéides du Pérou. Bull. de la Soc. Imp. des Nat. de Moscou, T. L III, 1878, No. 4, p. 373.

♂. Length of cephalothorax 2.3 mm; of abdomen 3 mm.

Legs 9.2, 8.6, 8.8, 8.7.

Cephalic part a little shorter than thoracic. Quadrangle of eyes nearly one-fourth wider than long. Eyes of first row twice as large as those of second. Eyes of second row placed directly above those of first, forming a row equally wide, looking forward. Clypeus only a line. Falces very weak, vertical, parallel, as long as face; fang very short. Maxillae and labium unusually short. Maxillæ rounded and a little enlarged at their extremities, which are quite close together, excavated on their inner sides for the labium. Labium a little longer than wide, rounded at tip, one-half as long as maxillæ. Legs 1, 3, 4. 2; femur of the first not quite so long as femur with patella of the second. Palpus with patella and tibia equally long; patella and tibia two-thirds as long as tarsus. Tibia with a stout fringe of hairs on the outer edge. Tarsus with one spine on dorsum of enlarged part behind middle.

Coloration (dry): Upper surface of cephalothorax jet black, with two indistinct brownish spots on thoracic part, and a few long white hairs on eye-region. Clypeus black. Abdomen above, black, thinly covered with whitish hairs, and having two indistinct brownish spots behind the middle. Falces black with extremities and fangs pale yellow. Mouthparts black; sternum black with a large pale yellow spot in center. Venter pale yellowish, excepting the anterior and posterior ends, which are pale. Legs light yellow, excepting tarsus of the first, and tips of other legs which are black. Palpus black, except that part of the tarsus which projects beyond the bulb which is pale yellow.

Habitat: Peru.

From the collection of Dr. Taczanowski.

The jet black body and pale legs of this species quickly distinguish it from all members of this group.

LYSSOMANES AMAZONICUS N. Sp.

Plate XII, figures 1, 16.

♂. Length of cephalothorax 2.5 mm; of abdomen 4.4 mm.
Legs 12.5, 11, 10.8, 10.8.
♀. Length of cephalothorax 2.5 mm; of abdomen 5 mm.
Legs 11.3, 10, 9.4, 9.2.

Cephalic part (♂) as long (♀) not quite so long as thoracic. Quadrangle of eyes one-fifth wider than long. Eyes of first row three times as large as those of second. Second and first rows equally wide. Clypeus one-third as high as anterior eyes. Falces rather stout, diverging, not quite vertical, one-third longer than face; on the front of each falx just above insertion of fang, is a line of three stout hairs. Maxillæ rounded and a little enlarged at their extremities. Labium longer than wide, blunt and slightly narrower at extremity, and a little more than one-half as long as maxillæ. Legs 1, 2, 3, 4; femur of the first not so long as femur with patella of the second. (♂) Palpus with tibia plainly longer than patella; patella and tibia plainly less than one-half as long as tarsus. Femur with two spines at distal end and one in the middle; patella with one long hair at extremity; tibia with one stout hair at distal end on inner side.

Coloration (under alcohol): ♂. Light yellow. Eye-region covered with white hairs; there is an abbreviated central longitudinal black line on the thoracic region, and a black line around the lower margin. The abdomen has two longitudinal brown bands throughout its length which are enlarged at the middle point and again at the posterior end to form two pairs of spots. The spinnerets are brown. The legs grow darker toward their extremities and are tipped with black. ♀. Yellowish white. Cephalothorax like ♂ excepting that there is no dark marginal line. Abdomen with two pairs of brown spots, and with the spinnerets pale. The color is paler and the marks less distinct than in the ♂.

Habitat: South America (Amazon).

From the collection of M. Simon.

The male of this species differs from all others in the greater relative length of the tarsus of the palpus, the tarsus being more than twice as long as the patella and tibia together.

LYSSOMANES BLANDUS N. Sp.

Plate XII, figure 13.

♀. Length of cephalothorax 2.8 mm.; of abdomen 4.6 mm.

Legs 12.3, 10, 9.6, 9.6.

Cephalic part as long as thoracic. Quadrangle of eyes one-fourth wider than long. Eyes of first row twice as large as those of second. First and second rows equally wide. Clypeus one-half as high as anterior eyes. Falces robust, nearly horizontal, one and one-half times as long as face. Maxillæ a little enlarged and rounded at their extremities, slightly excavated on their inner sides. Labium longer than wide, a little more than one-half as long as maxillæ, widest in the middle, blunt at extremity. Legs 1, 2, 3, 4; femur of the first shorter than femur with patella of the second.

Coloration (under alcohol): Cephalothorax light yellow; eye-region surrounded with red and white hairs; anterior thoracic part with a dark central longitudinal line. Abdomen white with scattered light brown hairs; on the posterior part of the dorsum are two abbreviated, longitudinal, light brown bands, and there are some irregular, light brown spots on the anterior part. Falces, legs, palpi, mouthparts and sternum all pale yellow.

Habitat: Guatemala.

GENUS ASAMONEA (Cambridge) Simon.

Cephalothorax low; cephalic plate usually but little higher than thorax, occupying a little more than one-third of the cephalothorax.

Eyes in four transverse rows of two each. Eyes of first row close together, from two and one-half to three times as large as those of second row (relatively larger than in Lyssomanes), occupying the entire face. Second row of eyes wider than first. Eyes of third row much nearer the second than the fourth and much nearer together than those of second row; third row narrower than second, and sometimes wider, sometimes narrower than fourth. Eyes of fourth row about as large as those of second and nearer together. Quadrangle formed by second and fourth rows, at least twice as wide as long.

Sternum little, if any, longer than wide, truncated in front.

Coxæ separated by the width of the labium and part or all of that of the maxillæ.

Labium at least as wide as long.

Abdomen long, slender, tapering.

Legs slender; (♂) 1 4 3 2 or 1 4 2 3; (♀) fourth leg longest, others nearly equal. Femoral, tibial, metatarsal and sometimes patellary spines on the four pairs.

A. Eyes of third row but little smaller than those of the fourth.

MALES.

General color light; integument covered with silvery hairs	*puella.* (South Africa).
General color dark	*tenuipes.* (Ceylon.)

FEMALES.

1	First and third legs equal	*tenuipes.* (Ceylon).
	First and third legs not equal	2
2	Legs 4 1 2 3	*puella.* (South Africa).
	Legs not 4 1 2 3	3
3	Legs 4 3 $\overline{2\ 1}$	*punctata.* (Madagascar).
	Legs 4 $\overline{2\ 3}$ 1	*ornatissima.* (Madagascar).

ASAMONEA PUELLA Simon. 1885.

Asamonea puella Simon. Bull. de la Soc. Zool. 1885, T. X. p. 27.

Having no mature specimen of this species we translate the following description from Simon:

♂. Length 6 mm. Cephalothorax yellowish testaceous narrowly bordered with brownish, with the cephalic part covered with yellow hair, and having on each side a large black three-lobed spot which surrounds the eyes; the thoracic part, above, with two lines covered with thin red hairs which come together posteriorly. Clypeus very high, smooth behind the falces, above the eyes densely pubescent, in the middle silvery, on each side reddish. Abdomen steeply elongate, covered with hairs which are whitish testaceous and silvery white, adorned above with two lines, prettily interrupted with red. Spinnerets testaceous, upper ones brownish. Falces yellow testaceous, cut transversely by a black band in front. Sternum testaceous. Legs testaceous, femora with brownish lines below; tibia of fourth from base to apex, minutely dotted with brown; abundantly armed with long and delicate spines. Palpi testaceous with the stout femur armed below, back of the middle, with an obtuse tubercle; patella short; tibia not longer than patella, slightly thicker on the outside and enlarged into a keel-shaped laminate apophysis which is a little thickened and obtuse in the middle and very sharply prolonged above; the large tarsus longer than the femur and much thicker, convex and attenuated longitudinally with a large convex bulb.

♀. Length 7 mm. Cephalothorax with no lines on thoracic part. Clypeus, behind falces smooth, above eyes covered all over with silvery hair. Falces and legs uniform yellow testaceous without lines or spots. Region of epigynum, anteriorly, with a transverse pit obtusely triangular and much broader than long; posteriorily, a shining reddish transverse spot.

ASAMONEA TENUIPES Camb. 1869.

Plate XII, figures 5, 19, 19a, 19b.

Lyssomanes tenuipes Camb., Ann. and Mag. Nat. Hist. S. 4, vol. 3, p, 65.

♂. Length of cephalothorax 1.5 mm; of abdomen 2 mm.

Legs 6, 5, 5, 5.3.

♀. Length of cephalothorax 1.7 mm; of abdomen 3 mm.

Legs 5.5, —, 5.5, —. (Second and fourth wanting.)

Cephalic part scarcely more than one-half as long as thoracic, in ♂ with front and sides projecting like carapace of turtle. Quadrangle of eyes twice as wide as long. Eyes of first row two and one-half times as large as those of second row. Clypeus about one-half as high as anterior eyes. Falces very weak, ♂ inclined backward, ♀ vertical, ♂ scarcely as long as face, almost quadrate, ♀ as long as face; fang very weak. Maxillæ short, truncated, ♂ a little narrower, ♀ a little wider at their extremities. Labium wider than long, wider in ♂ than in ♀, ♂ one-third, ♀ a little less than one-half as long as maxillæ, blunt at extremity. Legs, ♂ $1, \overline{4, 3, 2}$; ♀ first and third equal. Coxæ of the first separated by the width of maxillæ and labium. Femur of the first plainly shorter than femur with patella of the second. Superior spinnerets elongated, in ♂, curved upward.

Coloration (dry): ♂. Cephalothorax dark brown, covered with whitish iridescent scales; a pale central band extends from the anterior eyes to the posterior border, and from this, curved white bands extend around the outer sides of the eye-region; the anterior part of the eye-region is covered with long white hairs. Clypeus covered with highly iridescent scales. Palpi, dark brown. Sternum and coxæ, pale. Abdomen, above and below, dark brown, shading to blackish on the sides, with a wide irregular pale ring near the posterior end: apex and curved spinnerets jet black; the whole abdomen is thinly covered with iridescent scales like those on the cephalothorax. Legs pale yellow; those of the first and second pairs have three black spots on the posterior side, one at the distal end of the femur, one at the proximal and one at the distal end of the patella; the tips of all the legs are black. Spines yellow.

♀. Light yellow with thick snowy white hairs on eye region and clypeus. Legs tipped with black.

Habitat: Ceylon.

ASAMONEA PUNCTATA N. Sp.

Plate 12, figure 20.

♀. Length of cephalothorax 2.8 mm; of abdomen 5 mm.

Legs 8.7, 9, 9.5, 10.5.

We have also an immature ♂ of this species.

Cephalic part a little more than one-half as long as thoracic. Quadrangle of eyes more than twice as wide as long. Eyes of first row three times as large as those of second row. Clypeus fully one-half as high as anterior eyes. Falces weak, vertical, parallel, as long as face; fang weak. Maxillæ rounded, a little enlarged at their extremities. Labium rounded, ♂ wider than long, ♀ as wide as long; less than one-half as long as maxillæ. Legs 4, 3, 2, 1; femur of the first shorter than femur of the second. Spines unusually long and stout.

Coloration (under alcohol): ♀. Pale yellow, with an indistinct dark median line on the thoracic part of the cephalothorax, and three equi-distant pairs of dark brown dots on the abdomen arranged in two lines of three dots each, the posterior pair of dots being only a little behind the middle of the abdomen. The tips of the legs are black, but the spines are light colored. When the spider is dried a small tuft of black hairs becomes visible at the anterior end of the abdomen. ♂. Upper surface of cephalothorax light brown, excepting on eye-region and anterior thoracic part, where it is pale yellow; on each side of the posterior thoracic part are two dark brown dots. Abdomen with four pairs of dark brown dots at equal distances between the two ends, the first three pairs converging toward the posterior end, the two dots of the fourth pair being placed further apart than any of the others. Probably a fourth pair of dots has been effaced from the abdomen of our female specimen.

Habitat: Madagascar.

ASAMONEA ORNATISSIMA N. Sp.

Plate XII, figure 22.

♀. Length of cephalothorax 2 mm; of abdomen 3 mm.

Legs 6.2, 6.6, 6.4, 7.

Cephalic part a little more than one-half as long as thoracic. Quadrangle of eyes twice as wide as long. Eyes of first row about two and one-half times as large as those of second row. Clypeus nearly one-third as high as anterior eyes. Falces weak, parallel, vertical, as long as the face, fang weak. Maxillæ rounded and very little enlarged at their extremities. Labium rounded, wider than long, less than one-half as long as maxillæ. Legs 4, 2, 3, 1; femur of the first about as long as femur of the second. Spines growing more slender from the first leg to the fourth.

Coloration (dry): Eye region covered with hairs of a rich brownish red color, with a wide central band of silver hairs extending between the eyes of the third row; thoracic part pale, without hairs. Clypeus with a band of silver hairs. Falces, and entire under side, pale yellow. Upper surface of abdomen covered with hairs of a rich brownish red, encircled by a band of silvery hairs, and having three spots of silvery hairs on the dorsum, the anterior one being the smallest, and the second and third broader. Legs pale, with light brown spines and black tips.

Habitat: Madagascar.

B. Eyes of third row much smaller than those of fourth (not more than one-third as large.)

Under this head we have only two individuals of different sexes. The male is *gracilis*, French Guiana, and the female *flava*, Central America.

ASAMONEA GRACILIS Tacz. 1875.

Plate XII, figure 2.

Jelskia gracilis Tacz., Les Aranéides de Guyane française, Horae Soc. Ent. Ross., T. VIII, pp. 32–132.

♂. Length of cephalothorax 1.8 mm.; of abdomen 4 mm.

Legs 11, 9, 10.8, 10.4.

Cephalic part not quite so long as thoracic. Quadrangle of eyes more than twice as wide as long. Eyes of the first row three times as large as those of second row, projecting. Clypeus nearly one-half as high as anterior eyes. Falces very weak, vertical, as long as face; fang weak. Maxillæ rounded and a little enlarged at their extremities, slightly inclined toward labium. Labium as wide as long, about one-half as long as maxillæ. Maxilliæ and labium unusually short. Legs 1, 4, 3, 2, very long and fine. Coxæ of the first more widely separated than usual — by fully the width of maxillæ and labium. Femur of the first about as long as femur with patella of the second.

Coloration: Cephalothorax and abdomen, both above and beneath, polished black, with bluish iridescent reflections. Legs very pale yellow with pale spines and hairs; on the upper surface of the first leg a black line begins on the trochanter and extends throughout half the length of the femur; there is a similar line on the upper surface of the second leg, but here it is much shorter and finer. Falces pale yellow with a black spot on the anterior face of each. Mouthparts pale yellow. Palpus black excepting the tarsus, which is light reddish yellow.

Habitat: French Guiana.

From the collection of Dr. Taczanowski.

ASAMONEA FLAVA N. Sp.

Plate XII, figure 18.

♀. Length of cephalothorax 1.8 mm; of abdomen 3.8 mm.

Legs 11.8, 10.8, 11.6, 13.

Cephalic part a little more than one-half as long as thoracic. Quadrangle of eyes twice as wide as long. Eyes of first row two and one-half times as large as those of second row. Clypeus one-third as high as anterior eyes. Falces weak, shorter than face, slightly inclined backward. Maxillæ truncated, and a little enlarged at their extremities. Labium a little wider than long, less than one-half as long as maxillæ, rounded. Legs 4, 1, 3, 2. Femur of the first scarcely longer than femur of the second. Spines very few in number, and extremely weak, scarcely more than hairs. The abdomen, which is somewhat injured, seems to have been cylindrical in shape and truncated behind. Superior spinnerets not so much elongated as is usual in this genus.

Coloration (under alcohol): Light yellow; on all the legs the tibial joints have two dark brown spots at each end; the metatarsi have two brown spots at the proximal end and the metatarsus of the first has one brown spot at the distal end; the tarsi of all the legs have the distal fifth dark brown. Spines matching the legs in color.

Habitat: Central America.

LYSSOMANES PALLENS Blackwall. 1887.

Lyssomanes pallens, Blackwall, Proc. Royal Irish Acad., 1877, Vol. III, Ser. 2, p. 6.

Having no specimen of this species, we are unable to determine its genus, although, to judge from the drawings, it belongs to the second division of *Asamonea*. We quote the whole description as given by Blackwall:

"Length of an immature male (not including the spinners), one-fifth of an inch; length of the cepholothorax, one-sixteenth; breadth, one-sixteenth; breadth of the abdomen, one-twentieth; length of a posterior leg, one-fourth; length of an anterior leg, five-twenty-fourths. The color of this spider is white tinged with yellow, particularly on the sides and base of the cephalothorax. The eyes are disposed on the anterior part of the cephalothorax; two, which are situated in front, are much the largest, and are prominent, pellucid, and almost in contact; on each side of the upper part of the cephalic region these eyes are placed in the form of an irregular triangle, on small tubercles seated on confluent black spots, the intermediate eye, constituting the vertex of an obtuse angle, being the smallest of the eight. The cephalothorax is somewhat quadrate, convex, glossy, slightly

rounded on the sides and at the base, and moderately elevated in the cephalic region. The falces are small, sub-conical, and inclined toward the sternum, which is broad, convex, and heart-shaped; the maxillæ are short, rounded at the extremity, and inclined toward the lip, which is somewhat quadrate, being broader at the base than at the apex. The legs are slender. and provided with hairs and long spines, two parallel rows of the latter extending along the inferior surface of the tibia and metatarsus of the first and second pairs; each tarsus is terminated by two minute, curved claws, below which there is a small black scopula. The abdomen is long, sub-cylindrical, and has a few short, pale hairs distributed over its surface. The superior spinners are the longest, and their terminal joint, which is pointed, has the spinning-tubes arranged on its inferior surface. The palpi of the specimen from which the description was made were very tumid, but the palpal organs were not developed, indicating that it probably had to undergo its final change of integument before it arrived at maturity; the radial was stronger than the cubital joint, and prominent in front."

GROUP II. ATHAMII.

GENUS ATHAMAS Cambridge.

Cephalothorax high, short, quadrate, very convex above, sloping steeply behind and on the sides. Caput occupying at least one-half of cephalothorax. Eyes arranged in four transverse rows of two each. Eyes of first row large and close together. Eyes of second row two-thirds as large as those of first, forming a wider row. Eyes of third row half way between second and fourth rows, and about one-third as large as those of fourth row. Eyes of fourth row smaller than those of second and nearer together. Quadrangle formed by second and fourth rows as long as wide. Labium about as wide as long.

ATHAMAS WHITMEEI Cambridge. 1887.

Plate XII, figures 3, 11.

Athamas whitmeei Camb., Proc. Zool. Soc. of London, 1877, p. 576.

♂. Length of cephalothorax 1.6 mm; of abdomen 1.4 mm.

♀. Length of cephalothorax 1.25 mm; of abdomen, 1.75 mm.*

Legs 3.5, 2.5, 2.5, 3.

♂. Cephalic part a little longer than thoracic. Clypeus one-half as high as anterior eyes. Falces vertical, short. Maxillæ rounded and enlarged at extremities. Labium as wide as long, one-third as long as maxillæ. Sternum heart-shaped. Legs rather long and slender, those of the first pair stoutest and furnished with strong spines; relative length

* These are the measurements given by Koch. We have no female of this species.

1, 4, 3, 2. Abdomen small and short, slanting from the anterior part to the spinnerets.

Coloration: As our specimen is considerably rubbed we quote the color description given by Cambridge. "The *cephalothorax* of this very pretty and distinct spider, is of a yellow brown color, with a large pale patch on each side of the hinder extremity, and the ocular area black, thinly clothed with short white hairs, and shining, in some lights, with a strong, metallic, dark violet hue; a pale stripe densely clothed with bright white squamose hairs runs through the middle of the hinder half of the ocular area to the beginning of the posterior slope; there is also a spot of similar hairs on each side towards the hinder part, and another on each side near the hinder part of the ocular orea, just below the eyes of the third row. * * * The legs are yellow, the femora and the two other basal joints of the first pair being much stronger than the rest, and brownish black on each side. This, however, is apparently not a constant character; or at any rate it does not always exist at the first coming of the spider to maturity, but probably is acquired later; for in one of the examples before me the first pair are of the same color as the rest, and the femora of only ordinary comparative strength, and the legs themselves shorter and weaker. * * * The *palpi* are pale yellow. * * * The *falces* * * * are of a brownish yellow color with a broad rather oblique dark yellow-brown longitudinal stripe on the fore side. The *maxillæ* are yellow-brown, paler at their extremities. The *labium* is also yellow-brown, palest at the apex. The *sternum* is * * of a pale yellow color. The *abdomen* is of a palish yellow hue; on the fore half of the upper side a clearer yellow elongate-oblong central marking is indicated by a dark-brown dentated marginal line, and terminates posteriorly with a short transverse curved dark-brown stripe, behind which, again, are two longitudinal curved dark-brown markings inclosing a circular area covered densely with white squamose hairs which extends forward also to the transverse stripe above described. The sides are marked with a few dark-brown spots and markings; and on each side of the fore extremity of the oblong central marking is a large patch of white squamose hair. In front, below the fore margin, are some coarse, bristly, black, upturned hairs. The spinners are of a blackish hue, tipped with pale yellowish. * * * There is evidently some variety in the abdominal markings of this species, since in the other example before noted the upper side of the abdomen is generally suffused with dark blackish brown, showing faintly the longitudinal oblong central, yellowish marking on the fore part; the posterior and two anterior large patches of white squamose hairs, however, are even more conspicuous in this than in the other example."

As we have no female of this species we translate the description given by L. Koch, Arachniden Australiens, p. 1076, T. xciv.

♀. The cephalothorax is brownish with a narrow, black marginal band which is broadened in some places and a brownish, interrupted longitudinal stripe on the lateral declivity; the space between the eyes black with faint, blue iridescence. A median longitudinal stripe composed of brilliant yellow hairs begins on the posterior declivity and extends to the front row of eyes; the remaining hair of the cephalothorax is white mixed with pale yellow. The hair-rings around the eyes of the first and second rows orange-yellow and white, those of the first row above and below orange-yellow, without and within white. Falces dark brown; maxillæ, labium and sternum dirty brownish-yellow. Palpi and legs pale yellow; femur of the palpus with a black longitudinal stripe before and behind. Femur of the first with a black longitudinal stripe in front, and two black spots behind; femur of the second with two black spots in front and behind; femora of the third and fourth with a black ring on the basal half, and a small black spot on the terminal half before and behind. Patellæ with a black spot before and behind. The tibiæ and metatarsi have a black ring at the base and the tarsi are suffused with black at the base. Abdomen black above, with white and pale yellow hairs; from the base to a point in front of the middle runs a longitudinal band covered with deep yellow hairs. back of this, and again just in front of the spinnerets, a long spot covered with similar hair; specimens in alcohol show also the following markings which almost disappear completely in the dry animal; from the end of the longitudinal band above mentioned two undulating pale bands run first to the sides and thence in an arc back to the base, enclosing a space which is covered with pale reticulating veinlets; the posterior half of the upper surface is marked with small blue spots and streaks; the spinnerets brownish-yellow suffused with black.

Cephalothorax about one-sixth longer than broad, considerably longer than patella and tibia of the fourth, high, abrupt on the posterior edge, falling almost perpendicularly, faintly convex on the lateral perpendicular declivity, above, only slightly arched as far as the third row of eyes, but from these strongly convex, dull, covered with short hairs; the median, longitudinal stripe with hair-shaped scales; lateral margin with long black bristles which project outward; one very long anteriorly directed bristle between the eyes to the first row; clypeus as high as the radius of an eye of the first row. Eyes in four rows: quadrangle of the eyes longer than broad, narrowed behind; eyes of the fourth row as far again from the lateral borders as from each other, overhung by the lateral walls of the cephalothorax.* Eyes of the first row very large, close together and abutting on those of the second row; eyes of the second row placed above and slightly

* ". . . von der Seitenwand des Cephalothorax überragt."

projecting over those of the first, with their outer peripheries distant from one another by the diameter of one of the eyes of the first row. Eyes of the third row nearer to those of the second than to those of the fourth; those of the fourth smaller than those of the second row. Falces only a little longer than the breadth at the base, very glistening, smooth, slightly convex anteriorly, diverging on the inner side from the base. Maxillæ with outer and anterior margins straight, and inner margins also straight as far as the labium; the inner corners, consequently rather rectangular; the maxillæ are excavated along the labium; labium very short, broader than long, rounded anteriorly. Sternum cordate, slightly convex, dull, sparsely overgrown with projecting, long, yellowish hairs. Abdomen only slightly longer than broad, truncate in front, strongly convex laterally, acuminate toward the spinnerets, dull, covered with short adpressed and longer projecting hairs in many layers; the deep yellow markings formed by hair like scales. Legs short; femora convex above, underneath overgrown with long projecting hairs, with two spines above, those of the first pair with one spine above at the end. Tibiæ and metatarsi underneath beset with long spines. Spines of the patellæ, tibiæ and metatarsi of the third and fourth short. On tibiæ and metatarsi of the third and fourth above, long projecting hairs. Patella and tibia of the third as long as patella and tibia of the fourth; metatarsus and tarsus of the fourth longer than patella and tibia of the fourth.

Habitat: Tahiti, Upolu, Samoa.

GENUS EPEUS* PECKHAM.

1876. Evenus Simon, Ann. Soc. Entomol. de France (5), pp. 58–59.

1885. Epeus Peckham, Genera of Fam. Attidæ, p. 334.

Cephalothorax rather elongated; thoracic part scarcely the longer, sensibly dilated and rounded; cephalic part plane, elevated behind, inclined in front, longer than wide; superciliary projections pronounced. Median anterior eyes very large, almost touching, occupying the entire width of the face; the lateral eyes much smaller, separated, placed further back, forming a second line. Dorsal eyes as large as the laterals, a little nearer together since the sides converge behind. Clypeus almost as wide as the radius of the median anterior eyes. Falces short, vertical, not ridged. Sternum scarcely wider than the intermediate coxæ. Labium twice as long as wide, rounded at the tip. Coxæ of the first separated by at least the width

* In 1885, in our work on the Genera of the Attidæ, we substituted the name *Epeus* for Simon's name *Evenus*, this latter being preoccupied. It seems very probable that *Epeus* and *Athamas* should form but one genus, but we have no specimen of *Epeus*, and are unable, from the description given by Simon, to decide the point. The generic and specific descriptions of *Epeus* are translated from Simon.

of the labium, of the same length as the others. Legs: 3, 1, 2–4, long, the three first pairs equal in thickness, the fourth more slender; patella and tibia of the first longer than the cephalothorax, tibia much longer than patella; patella and tibia of the fourth much longer than patella and tibia of the third, and more slender; metatarsus and tarsus of the fourth at least as long as patella and tibia; on the two first pairs two rows of very long inferior tibial and metatarsal spines; tibiæ and metatarsi of the two posterior pairs furnished with slender spines throughout their length. Tarsal claws long, regularly curved; the external one provided with a series of five broad, short, conical teeth; the internal one with ten teeth which are longer, more slender, equal, close together.

EPEUS TENER Simon. 1876.

♀. Cephaloth.: length 3.6 mill., width 2.6 mill. Abd.: length 4.5 mill., width 1.5 mill. Legs: first 9 mill., second 8.4 mill., third 10 mill., fourth 8.4 mill.

White testaceous, with the circumference of the eyes black. Clypeus ornamented with thick, very white hairs. Cephalic square ornamented above with scaly pubescence of a brilliant, slightly gilded yellow, and on the sides with red pubesecence. Abdomen bright red above, with two fine lateral yellow lines. Legs and palpi glabrous.

Malamoy, Bassilan Island (Philippine Islands).

GROUP III. SIMONELLII.

GENUS SIMONELLA Peckham.

Body long, slender, nodose. Cephalothorax more than twice as long as wide, convex above, constricted near the middle; thoracic part twice as long as cephalic. Eyes very unequal in size, placed in four transverse rows of two each, those of the anterior row nearly touching; quadrangle formed by the second and fourth rows of eyes, equally wide in front and behind or wider behind than in front, and wider than long. Eyes of the third row very small, sometimes halfway between the second and fourth rows, sometimes nearer the second than the fourth.

Legs slender, differing but little in thickness; relative length 4, 3, 1, 2.

Abdomen long and slender, sometimes constricted in the middle.

SIMONELLA AMERICANA Peckham. 1885.

Plate XII, figure 4.

Simonella americana P., Proc. Nat. Hist. Soc. of Wisconsin, p. 24.

♂. Total length 8.5 mm. Width of of abdomen 1.1 mm.

Length of cephalothorax 3.5 mm; width 1.4 mm; height 1.2 mm.

Legs 3.8, 3.6, 4, 5.3.

Cephalothorax nearly as high as wide; cephalic and anterior thoracic parts higher and more convex than the remaining portion of the thoracic, from which they are separated by a well-marked constriction; that part of the thorax posterior to the constriction is highest in the middle, and slants off to form the narrow pedicle by which it is united to the abdomen. The cephalic and anterior thoracic parts are jet black and glabrous; the posterior thoracic part is pale yellow. Eyes of first row more than twice as large as those of the second; second row wider than the first; third row nearer the second than the fourth; eyes of fourth row about as large as those of second and further apart.

Clypeus less than one-half as high as anterior eyes, retreating; ridged above; color black. Palpus black, long and slender, having on outer side of tibia a stout apophysis. Falces robust, narrowing toward the tip, long, vertical, slightly diverging; fang as long as the palpus, slender, yellowish black in color. Maxillæ yelowish black, half as long as palpus, more than twice as long as labium; widest at their extremities. Labium as wide as long, truncated at tip.

Sternum yellowish, long, truncated in front, narrowing to a point behind.

Legs with weak tibial and metatarsal spines on the first pair; second, third and fourth pairs unarmed. Patella and tibia of the third, shorter than patella and tibia of the fourth; metatarsus and tarsus of the fourth, shorter than patella and tibia of the fourth. Patella, tibia and metatarsus of the first black on the inner side; otherwise all the legs are yellowish with a darker shading toward the distal ends of of those of the fourth pair. Abdomen made up of three parts, the middle part being a narrow neck which joins the anterior and posterior portions. The anterior is twice as long as the middle, and half as long as the posterior part.

Habitat: Guatemala.

This species was found running on the ground among leaf-cutting ants.

SIMONELLA MYRMECIÆFORMIS* TACZANOWSKI. 1874.

Plate XII. figure 8.

Janus myrmeciæformis Tacz., Les Aranéides de la Guyane française, p. 94.

Eyes in four rows; cephalothorax in two parts, abdomen with a marked constriction in the middle; general color ochre yellow, four black spots on the head, two pale rings on the abdomen. Length ♂ 7 mm.

♂. The cephalothorax is very slender and much elongated, with the head a little longer than wide, distinctly separated by a marked constriction across the back and throughout the height of sides; the thoracic part considerably longer than the head, a little narrower and composed of three distinct portions of which the anterior represents a short slightly contracted neck, which is followed by a convex knob, behind which is a rather long pedicle which is more slender than the neck; the cephalic plate is lightly arched and inclined forward; the lateral contours of the head are arched; behind it is terminated by a facet with a gentle slope. Eyes in four rows, in a quadrangle a little longer than wide;† those of the first row very large, in contact, and occupying the entire height and width of the face; those of the second pair behind on the lateral border of the back at a considerable distance from the preceding ones, and directed upward; eyes of the third pair halfway between those of the second and fourth; external border of the anterior eyes in a straight line and parallel with those of the other pairs. Falces short, thick and vertical. Abdomen longer and more slender than the cephalothorax, strongly constricted in the middle so as to form three distinct parts, of which the anterior is cylindrical, almost horizontal, the second very slender and strongly bent and the posterior elliptical, of the same breadth, but much longer than the anterior, that is to say the whole resembles an S faintly bent and enlarged at the two extremities. The spinnerets are short. The legs are slender and of moderate length, in the order 4, 3, 1, 2. Palpi short, thicker than the legs, with the tibæ short and stouter than the femora. The body is entirely bare, only a few hairs being found around the anterior eyes, on the tarsi of the palpi, and some which are almost imperceptible on the legs.

Coloration: The general color is a pale ochre yellow; two large black spots are found on each side of the head at the base of the eyes, the anterior one of which extends between those of the second and third

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* The descriptions of this species and of *lucasii* are translated from Dr. Taczanowski.

† This is true when the quadrangle is understood to include the first row of eyes; when we use the expression "quadrangle of the eyes" in relation to the Lyssomanæ (as in defining this genus) we refer to the quadrangle formed by the *second* and *fourth* rows of eyes.

pairs; two wide rings clearer than the general color are found around the abdomen, the first being in the middle of the anterior part, the second on the constriction. In the individual from Saint Laurent de Maroni the posterior part of the abdomen is grayish, much deeper than the rest of the body. The legs are of the color of the body but a little paler. The anterior eyes are amber yellow, the others blackish.

Two males from Cayenne and St. Laurent de Maroni; female unknown.

SIMONELLA LUCASII Taczanowski. 1874.

Plate XII, figure 9.

Janus lucasii Tacz., Les Aranéides de la Guyane française, p. 96.

Eyes in four rows; cephalothorax in two parts, abdomen with a constriction near the base; color of cephalothorax reddish yellow; four black spots on the head; abdomen grayish. Length ♀ 4 mm.

♀. Cephalothorax slender and elongated, with the head square, distinctly separated from the thoracic part by a strong constriction, terminated behind by an inclined slope. The sides parallel and perpendicular; the thoracic part longer but not so wide as the head, is comopsed of a much contracted but short neck, followed by a globular knob, which is terminated behind by a short pedicle which is more slender than the anterior constriction. The eyes are in four rows, but are arranged a little differently from those of the preceding species; the ocular quadrangle is a little longer than wide;* the anterior eyes are large, in contact, occupying the entire front of the vertical inclination of the face; the second pair is placed on the back behind the eyes of the first pair, but they are a little further from each other than the distance between the external borders of the first ones, and are directed sideways; the posterior eyes are larger, but are separated by the same distance as those of the second row, the eyes of the third pair halfway between the second and fourth. The falces are short, thick and vertical. The abdomen is of the same length as the cephalothorax, thicker, commencing by a short pedicle which appears to constitute a prolongation of that of the thoracic part; behind this it suddenly grows larger up to the middle of its length and then grows smaller again so as to terminate in a point. The legs are slender and not very long, in the order 4, 3, 1, 2. All the body is glabrous, with some sparse hairs, which are rather long on the upper part of the head, and on the posterior part of the back of the abdomen.

*The quadrangle is wider than long if the second row of eyes is taken as its anterior line. See note under preceding species.

Coloration: The color of the cephalothorax is reddish yellow, two black spots on each side of the head of which the anterior one includes the base of the eyes of the second and third pair. The abdomen is grayish yellow. The legs are pale yellow; the femora and the patellæ in the two posterior pairs are of a brownish gray, so as to form a wide clear ring at the origin of the leg. The anterior eyes yellow, the others black.

A single female from Uassa.

DESCRIPTION OF PLATES.

PLATE XI.

1. Lyssomanes antillanus, palpus of ♂.
2. " unicolor, palpus of ♂.
3. " viridis, palpus of ♂.
4. " bi-tæniatus, palpus of ♂.
5. " placidus, palpus of ♂.
6. " miniaceus, palpus of ♂.
7. " austerus, palpus of ♂.
8. " tenuis, palpus of ♂.
9. " jemineus, palpus of ♂.
10. " nigro-pictus, palpus of ♂.
11. " velox, palpus of ♂.
12. " longipes, palpus of ♂.
13. " robustus, palpus of ♂.

PLATE XII.

1. Lyssomanes amazonicus, palpus of ♂.
2. Asamonea gracilis, palpus of ♂.
3. Athamas whitmeei, palpus of ♂ (after Keyserling).
4. Simonella americana, palpus of ♂.
5. Asamonea tenuipes, palpus of ♂.
6. Lyssomanes viridis, epigynum; 6a, eyes; 6b, falces of ♀.
7. Lyssomanes robustus, eyes.
8. Simonella myrmeciæformis, cephalothorax (after Taczanowski).
9. Simonella lucasii, cephalothorax (after Taczanowski).
10. Lyssomanes modestus, epigynum.
11. Athamas whitmeei, epigynum (after Keyserling).

12. Lyssomanes tristis, epigynum.
13. " blandus, epigynum.
14. " jemineus, epigynum.
15. " parallelus, epigynum.
16. " amazonicus, epigynum.
17. " austerus, epigynum.
18. Asamonea flava, epigynum.
19. " tenuipes, epigynum; 19a, eyes; 19b, falces.
20. Asamonea punctata, epigynum.
21. Lyssomanes unicolor, epigynum.
22. Asamonea ornatissima, epigynum.

O. M. CONOVER.

By WM. F. ALLEN.

In the spring of 1884, the Academy experienced the loss of one of its most valued members, in the death of Obediah Milton Conover, which occurred in London, April 29 of that year. He was at the time on his way home from a two years' sojourn in Greece and Germany. His remains were brought to this city, and were committed to the earth in Forest Hill Cemetery, on the 28th of May.

Dr. Conover was of Dutch origin, being the seventh in the line of descent from Jacob Wolfertson van Kouwenhoven, who came to this country at its first settlement, in company with the Patroon van Renssellaer. On what occasion the name was changed to its present form is uncertain. His mother, Sarah Miller, was of a Kentucky family. He was born in Dayton, Ohio, October 8, 1825; prepared for college in that city, and graduated at Princeton in 1844, afterwards studying theology in the same institution (graduating in 1849), without, however, entering the profession of the ministry. In the interval of two years between his graduation and his theological course, he taught school near Lexington, Ky., and in Dayton. While at Dayton he also studied law in the office of Gen. Robert C. Schenck; and this was the profession he finally adopted, being admitted to the Dane county bar in 1859.

In 1849 he was married and came directly to Madison, where he resided the remainder of his life; his wife died in 1863. At first he was engaged in the publication of *The Northwestern Journal*, a literary and educational monthly, of which only a few numbers were published. In 1850 he was made professor of ancient languages in our University; an office which he held until 1858. It was the day of small things for the University, but no institution could be insignificant, or could fail to exert a strong and lasting influence, whose faculty consisted of three such men as Chancellor Lathrop, Professor Sterling and Dr. Conover. In 1859, as has already been said, he was admitted to the Dane County bar; two years later he became assistant reporter to the Supreme Court, and in 1864 was appointed reporter, which office he held until his death, a term of twenty years. During some years he held also the office of State Librarian. In 1879 he received from the University the degree of Doctor of Laws. In September, 1882, he was married to Mrs. Sarah Fairchild Dean, and they immediately went to Greece, where they spent the ensuing winter.

Mr. Conover was not a man of showy parts, and neither his disposition nor his taste led him to seek publicity. Besides this, in the later years of

his life the condition of his health did not permit him to undertake any but necessary routine labors. For these reasons he was seen but little except by his nearest friends, or in the performance of his public duties; and it was only those who were closely associated with him who were able to estimate him at his true worth. The community, however, did not fail to appreciate his high qualities. He was equally characterized by accuracy of information, soundness of judgment, and a high standard of conduct; and these qualities combined gave him an influence the strength and extent of which he was himself probably far from suspecting. It may be said that no man among us inspired more universal confidence, or was regarded with more universal esteem. Always courteous and unassuming, he was a man of strong convictions, and held to his opinions with great tenacity, although without intolerance.

In his public duties, as reporter to the Supreme Court, all his best intellectual qualities found room for exercise. His published reports, if I am rightly informed, rank among the best of their class. But while performing his professional duties faithfully and with high intelligence, he found his truest enjoyment in the study of literature — using this word in its highest significance. He was familiar with the best that has been said by the great creative minds of the world, and his fine taste and correct judgment were nowhere more marked than here. It was the chief happiness of his life that at its very close he was enabled to gratify this taste without stint, and in the most congenial companionship. The master spirits of Greek literature had always been his favorite writers; and the winter spent by him in Athens, where the American School of Classical Studies had just been established, brought him into direct and loving communion with the choicest memories of classical antiquity. Much as his friends in Madison regret that he was separated from them during the last two years of his life, they recognize that this experience was to him the greatest happiness that he could have wished. His relations to literature were, however, for the most part those of enjoyment and culture. He wrote very little himself, but that of a quality which one would wish to see more common. The members of the Madison Literary Club will remember with high appreciation the few papers which he read before them; and to most of us it was no doubt an unexpected, although by no means a surprising revelation, when he came to be known as being possessed of a poetic faculty, genuine, although rarely exercised.

As a member of our Academy there is little to be said of him. He had not the physical strength to do any work for it. I do not remember that he ever took an active part in its proceedings; but its members always felt it as a privilege and an honor to count him as one of themselves.

PROCEEDINGS OF THE ACADEMY SINCE DECEMBER, 1883.

REPORT OF THE SECRETARY.

FIFTEENTH REGULAR ANNUAL MEETING.

Held at Madison, Wisconsin.

ROOMS OF WISCONSIN ACADEMY OF
SCIENCES, ARTS AND LETTERS,
CAPITOL, MADISON, WISCONSIN.

FIRST SESSION.

MONDAY EVENING, December 29, 1884.

The reports of President, Secretary and Treasurer were presented.

Messrs. Lamb, Allen and Blackstone were appointed a committee on Treasurer's report.

Dr. Hoy, Profs. Daniells and Sprague were appointed a committee on nominations for membership.

SECOND SESSION.

December 30, 1884.

Academy met at 9 A. M.

The report of the Treasurer, showing a balance in the Treasury of $742.38, was reported back from the Auditing Committee, and its adoption recommended. The report was adopted.

The following members were elected:

Mr. F. E. Short, Madison; Mr. G. H. J. Douglass, Madison; Prof. F. B. Power, Madison; Mr. Carl Doerflinger, Milwaukee; Prof. A. J. Rogers, Milwaukee.

Voted: That a credit of $3.00 on his annual dues be allowed to Rev. S. D. Peet for his American Antiquarian for 1884.

Voted: That Prof. W. F. Allen be requested to prepare a memorial of Prof. O. M. Conover for the next volume of the Academy Transactions:

Dr. P. R. Hoy, of Racine, gave an interesting address on "How did the Indians make their stone implements?" The statements made by the doctor were somewhat startling to the gatherers of these ancient implements. Specimens of some of these very ancient implements were exhibited by the doctor, that had been made within the past six months, by a resident of our state, and not an Indian either.

Rev. S. D. Peet, of Clinton, addressed the Academy on recent investigations of the Indian mounds in this section of the state, particularly near the banks of Lakes Koshkonong and Mendota.

Mr. Peet also read a paper on the "Antiquity of Man in America," and the conclusion reached was that those who claimed the great antiquity of man in America had failed to prove their claims, and that the whole matter was still an open question.

The discussion of the question was continued by Prof. Birge, Dr. Hoy and Prof. Irving.

Prof. W. F. Allen read a paper on the "Changes in the Local Condition of the English Serfs during the Feudal Period."

AFTERNOON SESSION.

The first paper read was by Dr. P. R. Hoy, of Racine; on "Science and Society." The discussion of the subject was continued by Prof. J. S. Butler, Prof. E. A. Birge, Prof. Hoy, Prof. Peckham, Rev. S. D. Peet, and Prof. W. W. Daniells.

Prof. L. Heritage read an interesting paper "On the Date of the Dialogus de Oratoribus." The question was further discussed by Prof. W. F. Allen, Prof. E. S. Holden, Prof. Heritage and Prof. Butler.

Prof. C. A. Van Velzer gave an address on the "The Rapid Decomposition of Rotinal Fractions."

The question of the organization of affiliated societies came up for consideration, and was discussed by Prof. Birge, Prof. Peckham, Prof. Sprague, Prof. W. F. Allen, Prof. E. G. Smith, Dr. Hoy, Rev. S. D. Peet, Prof. Holden, A. O. Wright and Prof. Van Velzer.

Before acting upon the matter the meeting adjourned until 8 o'clock in the evening.

EVENING SESSION,

Academy called to order by Prof. T. C. Chamberlin, Vice-President.

The president, Prof. R. D. Irving, addressed the Academy on the subject of Geology in a most able and interesting manner.

The Academy then proceeded to the election of officers for the ensuing three years, which resulted as follows:

President — Prof. T. C. Chamberlin, Beloit.
Vice Presidents —
Department of Sciences — Prof. G. W. Peckham, Milwaukee.
Department of Arts — Prof. A. R. Sprague, Racine.
Department of Letters — Prof. W. F. Allen, Madison.
Secretary — Prof. E. A. Birge, Madison.
Treasurer — S. D. Hastings, Madison.
Curator of the Cabinet — Prof. C. R. Van Hise, Madison.
Librarian — Prof. E. A. Birge, Madison.

The matter of affiliated societies was again taken up and settled by the adoption of the following: Any local, scientific or literary society may apply for affiliation with the Academy, submitting its constitution, etc., to the inspection and approval of the Academy. If affiliated, it may propose for membership in the Academy such of its members as it shall select. These persons will be considered as nominated for membership in the Academy, and, if elected, will be entitled to all privileges of regular members. The society shall pay to the Academy one-half of the regular annual dues of the Academy for each person so elected, and will be entitled to as many copies of future volumes of the trans-

actions of the Academy as it contains members of the Academy. In case of the discontinuance of a local society, these persons can continue as members of the Academy on payment of the regular dues.

A list of the officers, and the names of the members and a copy of the minutes of the meetings of affiliated societies shall be forwarded to the Academy, and the whole or such portion as the council shall think best shall be published in the report of the transactions of the Academy.

SIXTEENTH REGULAR ANNUAL MEETING

Held at Madison, Wisconsin.

FIRST SESSION.

ROOMS OF THE AGRICULTURAL SOCIETY,
MONDAY, December 28, 1885, 8 P. M.

President T. C. Chamberlin in the chair.

The report of the Treasurer was read as follows:

Balance at opening of year	$742 38
Receipts	92 00
	$834 38
Payments	48 30
Balance, December 29, 1885	$786 08

Referred to committee consisting of Prof. Butler, Prof. Peckham, and Prof. Salisbury.

Professors Allen, Van Hise and Higley were appointed a committee on new members.

Professors E. S. Holden and Wm. Trelease having removed from the state were made corresponding members.

SECOND SESSION.

TUESDAY, December 29th, 9 A. M.

Paper: "On Darwin," Prof. E. A. Birge.

Paper: "The Village Community and Serfdom in England," Prof. W. F. Allen.

THIRD SESSION.

TUESDAY, 2 P. M.

Paper: "Overproduction," Pres. A. L. Chapin.

Paper: "James Bridges," Prof. J. D. Butler.

The Treasurer's report was, on report of auditing committee, approved.

E. Simon, of Paris, France, was made an honorary member.

Annual members elected:

H. W. Hilyer, Madison; H. H. Powers, Madison; L. M. Hoskins, Madison; M. A. Miner, Green Lake; Prof. A. W. Burr, Beloit; C. E. Eschweiler, Milwaukee.

FOURTH SESSION.

TUESDAY, 8 P. M.

One hundred dollars was appropriated for cuts.

One hundred dollars was appropriated for library.

President's address:

Paper: "Drift Phenomena of Dakota, Montana, Idaho, and Washington Territories."

FIFTH SESSION.

WEDNESDAY, December 30, 9 A. M.

Prof. A. R. Sprague in chair.

Paper: "Principles of Hydraulics not yet incorporated in Water Wheels," D. P. Blackstone.

Paper: "Northern Pitcher Plant," W. K. Higley.

SIXTH SESSION.

WEDNESDAY, 2:30 P. M.

Paper: "Process of Determining Nitrogen," H. P. Armsby.

SEVENTEENTH REGULAR ANNUAL MEETING,

Held at Madison, Wisconsin.

ACADEMY ROOMS, CAPITOL BUILDING,
DECEMBER 28, 1886, 8 P. M.

Reports of President and Secretary were given verbally.

Treasurer's report:

Balance at commencement of year	$786 08
Receipts	60 00
Interest	40 00
	$886 08
Expenditures	132 94
	$753 14

Examined by auditing committee, found correct, and adopted on report of committee.

WEDNESDAY, 10:00 A. M.

"The Basal Conglemorate of the Huronian,"
Professor R. D. Irving, - - - Madison.

"Constitution of the Residuary Clays,"
Professor R. D. Salisbury, - - - Beloit.

"Glacial Phenomena about the Head of Lake Michigan,"
President T. C. Chamberlin, - - - Beloit.

2:30 P. M.

"Bowlder Trains of Dodge, Dane and Rock Counties,"
Professor I. M. Buell, - - - - Madison.

"Disinfection,"
Professor F. B. Power, - - - Madison.

"Science and Society,"
Dr. P. R. Hoy, - - - - Racine.

"The Genesis of the Town,"
Professor W. F. Allen, - - - Madison.

7:30 P. M.

"Limitations of Political Economy,"
President John Bascom, - - - Madison.

"The Methods of Science,"
Professor J. J. Blaisdell, - - - Beloit.

Dr. Chapin and Prof. Allen were appointed a committee on new members.

Business.

Elected to membership:

Prof. T. B. Pray, Whitewater; Prof. J. J. Blaisdell, Beloit; Dr. C. O. Whitman, Milwaukee; Mr. E. P. Allis, Jr., Milwaukee; Mr. Chas. A. Carr, Madison; Mr. C. H. Sylvester, Boscobel.

Resolved, That the President and Curator be directed to provide for the proper care of the type set of fossils in the possession of the Academy.

Resolved, That the thanks of the Society be tendered to the Governor of the State, for the room which the State has given the Academy, in the Capitol Building.

EIGHTEENTH REGULAR ANNUAL MEETING,

Held at Madison, Wisconsin.

SENATE CHAMBER,
DECEMBER 29, 1887, 8 P. M.

President Chamberlin in the chair.

The reports of the officers were made, and that of the Treasurer was referred to the usual auditing committee.

Professors Wright, Pray, and Birge were appointed a committee on nomination of officers.

President T. C. Chamberlin then gave an address on "The Origin of the Extra-Moraine Drift."

Prof. W. F. Allen read a memorial of the late Dr. O. M. Conover.

Officers for the term of three years were then elected as follows:

President—W. F. Allen, Madison.

Vice-Presidents—Department of Sciences, F. H. King, River Falls; Department of Arts, A. J. Rogers, Milwaukee; Department of Letters, J. J. Blaisdell, Beloit.

Librarian—E. A. Birge, Madison.

Treasurer—Hon. S. D. Hastings, Madison.

Curator—C. R. Van Hise, Madison.

The election of Secretary was postponed for one day.

FRIDAY, December 30, 9 A. M.

The following persons were elected to membership:

Prof. C. R. Barnes, Prof. S. J. Browne, Prof. J. W. Stearns, Prof. G. C. Comstock, Prof. W. A. Henry, Dr. J. M. Dodson, Dr. H. B. Favill, R. G. Thwaits, F. J. Turner, L. M. Hoskins, F. G. Short, F. W. A. Woll, all of Madison; G. H. Balg, Mayville; Pres. E. D. Eaton, Beloit; Prof. J. R. Emery, Ft. Atkinson; Emory McClintock, Milwaukee; C. E. McLenegan, Milwaukee; W. H. Metcalf, Milwaukee; Dr. N. Senn, Milwaukee; Dr. J. T. Reeve, Appleton; Prof. J. W. Stump, Whitewater.

On motion, the report of the Auditing Committee, recommending the acceptance of the Treasurer's report, was adopted.

Professor W. F. Allen read a paper:

The Economic Disturbance in Rome, A. D. 33.

Professor Lucius Heritage on the reading:

Aliquid Quam in Tacitus De Oratoribus.

Professor J. D. Butler:

The Imagery of Dante.

The retiring Secretary, E. A. Birge, was made a life member.

FRIDAY, 2:30 P. M.

Papers.

Professor J. E. Davies:

Interpretation of certain Symbolical Facts in Mathematical Physics.

Also:

A Possibly New View of the Nature of the Electric Current.

Professor E. A. Birge:

Certain Zoogloeas described by Prof. Wm. Trelease.

Prof. G. W. Peckham, of Milwaukee, was elected Secretary.

Voted: That the Academy express its interest in the studies of Prof. W. K. Higley, of Chicago on "The Distribution of plants in Wisconsin."

FRIDAY, 8 P. M.

Papers read:

"Terminal Moraines in North Germany,"

Prof. R. D. Salisbury.

"The Raised Beaches of Lake Michigan,"

Mr. Frank Leverett.

Voted: That the expenses for the ensuing year be regulated by the council.

Adjourned *sine die.*

E. A. BIRGE,
Secretary.

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS.

LIFE MEMBERS.

Birge, Prof. E. A.
Case, Hon. J. I.
Dewey, Hon. Nelson
Delaplaine, Gen. Geo. P.
Davies, Prof. J. E.
Hill, James L.
Hoyt, Hon. John W.
Lawler, Hon. John
Mitchell, Hon. John L.
Paul, Hon. Geo. H.
Thorpe, Hon. J. G.

CORRESPONDING MEMBERS.

Cavenor, Rev. Chas.
Fallows, Bishop Samuel
Holland, Rev. F. May
Holden, Prof. E. S.
Knapp, Judge J. G.
Peet, Rev. S. D.
Steele, President G. M.
Sawyer, Prof. W. C.
Shipman, Col. S. V.
Trelease, Prof. Wm.

ACTIVE MEMBERS.

Allen, Prof. W. F.
Armsby, Prof. H. P.
Balz, Prof. G. H.
Barnes, Prof. C. R.
Blaisdell, Prof. J. J.
Burr, Prof. A. W.
Beatz, Hon. Henry
Buell, Prof. Ira M.
Bartlett, Dr. Edwin W.
Butler, Prof. J. D.
Beach, Prof. W. H.
Blackstone, Prof. D. P.
Conover, Mrs. Sarah F.
Cass, Prof. J. E.
Chapin, President A. L.
Chamberlin, Pres. T. C.
Carr, Chas. F., Esq.
Chandler, Prof. C. H.
Desmond, H. J., Esq.
Danley, Prof. J. H.
Draper, Hon. Lyman C.
Daniells, Prof. W. W.
Doyle, Hon. Peter
Day, Dr. F. H.
Emerson, Prof. Joseph
Fiske, Prof. E. O.
Foye, Prof. J. E.
Frankenburger, Prof. D. R.
Gordon, Mrs. Geo.
Greene, Thomas A., Esq.
Hutchinson, Hon. B. E.
Hastings, Hon. Sam. D.
Heritage, Prof. Lucius.
Hoy, Dr. P. R.
Holton, Hon. E. D
Higley, Prof. W. K.
Hillyer, Prof. H. W.
Hoskins, Prof. L. M.
Kerr, Prof. Alex.
King, Prof. F. H.
Lamb, F. J., Esq.
Lapham, Mary J.
Morgan, Prof. D. H.
Morris, W. A. P., Esq.
Meacham, Dr. J. G., Sr.
Meacham, Dr. J. G., Jr.
Marks, Solon, M. D.
Maxon, Rev. H. D.
Nader, Capt. John
Mills, Hon. Simeon
Norton, R. G., Esq.
Orton, Hon. H. S.
Olin, Mrs. D. A.
Perkins, Prof. H. B.
Peckham, Prof. G. W.
Parkinson, Prof. J. B.
Pray, Prof. T. B.
Power, Prof. F. B.
Rogers, A. J., Esq.
Smith, Prof. E. G.

ACTIVE MEMBERS — Continued.

Smeiding, Prof. Henry E.
Sprague, Prof. A. R.
Salisbury, Prof. R. D.
Sylvester, Prof. C. H.
Stump, Prof. J. W.
Somers, Rev. A. N.
Tatlock, Prof. John, Jr.
Viebahn, Prof. C. F.
Van Velzer, Prof. C. A.
Van Hise, Prof. C. R.
Whitford, Hon. W. C.
Wright, Prof. A. O.
Weyburn, Prof. L. A.
Wheeler, Prof. W. M.
Whitman, Prof. C. O.
Young, Rev. A. A.

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